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AUTOMATIC APPLIANCES.

The increasing use of automatic appliances is a noteworthy feature of the tendency in engineering development. Such devices are now used where a few years ago an attendant would be placed to care for the apparatus of the system. These appliances may take the form of regulators or governors for controlling the performance of the machines, or they may be protective devices which prevent damage that might be caused by unusual or unexpected conditions. In the electrical industries particular automatic appliances are largely used, and the results have been so good that we find the peculiar flexibility of electrical systems leading to their use for automatic apparatus in other lines of work. There is probably not an electrical system to-day, either for transportation purposes or power purposes in general, for lighting, telephone or for any of the various other applications of electricity, in which some automatic devices are not used.

In signaling work, particularly for railways, automatic electric systems seem to be carrying the day. These systems may take several forms. They may simply indicate to the man who controls the switches or signals that everything is going all right, or the system may be carried further and the signals themselves be operated automatically. Sometimes at an important switching point where there are many tracks to be controlled an electrical appliance is used to indicate to the operator which tracks are in use and which are vacant. A very pretty example of this kind of indicator has been installed on the Baker Street & Waterloo Railway, London, at junctions and crossings. In each switching station is placed a diagram of the tracks. Each section of these diagrams is automatically illuminated by an incandescent lamp whenever it is unoccupied, so that a glance at the diagram shows at once where trains are standing and where the track is vacant. The lighted portion of the track stands out sharply from the other, making an incorrect reading of the diagram almost impossible.

ELECTRICAL IRRIGATION.

Irrigation as usually thought of consists in conducting to the arid district water from a distance, either through pipes or by means of canals, and there distributing it. There is, however, another method of irrigation which may be applicable when the section to be watered is too far from the running streams. Such a system was described some time ago in a paper by Mr. F. E. Trask before the American Society of Civil Engineers. This is the system at Ontario, Cal.

The striking feature of the Ontario system is that instead of transporting water to the dry section, water is used to generate electrical energy, which is itself transported—or rather transmitted—to various points throughout the district to be watered and there used to operate pumps which draw the irrigating water from underground sources. Such an arrangement can only be adopted where there is an underground supply of water sufficiently large for the purpose. Moreover, an electrical system would probably be more expensive to install, except where the physical difficulties of constructing a canal are very great, or the distance through which the water is conducted is itself great. But there are no doubt many such situations to which water can be conducted only at a prohibitive cost. If, on the other hand, there is a water power not too far away, the electrical irrigating system might be used, for then the physical obstacles between the water and the farms are of not much importance and the cost of running a power line is much less than that of building an irrigating canal. The electrical power may be conducted over a small wire up hill and down, with equal facility; while water must be led in a large ditch built nearly level, or else in large, expensive pipes.

THE EFFECT OF STEAM PRESSURE ON THE ECONOMY OF STEAM TURBINES.

Although a great deal of data has been published on the performance of steam turbines, the conditions under which the many tests have been conducted have been so different that it is difficult to make a satisfactory comparison, and in this way see just what effect variations in steam pressure or in vacuum have on the performance of turbines of various sizes. Realizing the lack of satisfactory data on this phase of steam turbine operation, Messrs. T. Stevens and H. M. Hobart have collected a large number of results from turbines of the Parsons type, though of American and European makes, and have analyzed these and reduced them to such form as to enable a satisfactory comparison to be made. The particular point which Messrs. Stevens and Hobart wished to look into was to test the accuracy of a statement made some time since by Rateau, who has been urging the use of low-pressure steam turbines. Rateau said: "turbines are able to use to perfect advantage steam at a low pressure, for they have an efficiency rising in value as the pressure of the steam becomes lower." Taken literally, this statement might be questioned because experience with the reciprocating engine has demonstrated that the efficiency of the machine as a general thing increases with an increase in steam pressure. Comparatively speaking, the statement might be admitted, since the turbine loses less with decrease in pressure than does the reciprocating type.

Messrs. Stevens and Hobart have taken a great deal of pains in reducing and tabulating the results of their investigation, and have published these in a valuable article appearing in *Engineering* (London), March 2. They found that in some cases the steam consumption actually did increase with an increase in the steam pressure, though not generally so, and in the case where there was a lower efficiency at the higher pressure they attributed the greater losses to an increase in leakage and to the increased friction due to the motion of the blades in the denser steam. Their general conclusion regarding the effect of increased pressure is as follows: the improvement in economy from an absolute admission pressure of eight kilogrammes per square centimetre (109 pounds per square inch) upward for turbines of the Parsons type as at present designed and built, when operated with a good vacuum, is so slight as not to be worth taking into account.

Another result of the investigation is that turbines of the Parsons type consume about thirty-eight per cent more steam when running non-condensing than when running with a vacuum of twenty-six inches. This percentage may, of course, vary somewhat with different machines under different operating conditions.

The effect of superheat and of vacuum on the economy of the steam turbine has also been studied. For the former there is insufficient data to enable a complete analysis to be made. They have, however, determined that the economy obtained from superheating steam is greater for lightly loaded turbines than for those fully loaded. Roughly speaking, the gain from superheat is about twenty-five per cent more for a turbine at one-fifth load than at its normal rating. The effect of the vacuum is more clearly brought out, and this also shows that the increase in economy due to higher vacuum is more for light loads than for full loads. For example, increasing the vacuum from twenty-five to twenty-six inches decreases the consumption of steam at quarter load 5.3 per cent and at full load 3.6 per cent. For an increase in vacuum from twenty-six to twenty-seven inches the corresponding decreases in steam consumption are 6.6 per cent and 4.6 per cent; and an increase in the vacuum from twenty-seven to twenty-eight inches decreases the steam consumption at quarter load 9.6 per cent, and at full load six per cent. It is, of course, these features of the steam turbine which help give it such a flat characteristic of steam consumption. As is well known, the change in efficiency from quarter load to full load and over is much less than is the case with the reciprocating engine.

The general conclusions reached in this paper are that in a relative sense Rateau's statement is correct. The statement might be put the other way; that is, a reciprocating engine gains in economy with increase in steam pressure more rapidly than does the steam turbine. In fact with turbo-generating sets of the Parsons type the commercial efficiency at rated load is very nearly independent of the admission pressure. Steam turbines will therefore find a field of application at low steam pressures, where, so far as relates to steam economy, piston engines can not at present compete.

CHARGING FOR TELEPHONE SERVICE.

Generally at the introduction of a new industry having the nature of a public utility, it is customary to charge a flat rate for the service. There may be several flat rates based upon the kind of service given. Later, when a greater extension has been made, it is good business to introduce a measured service, so that each person may pay proportionally for what use he makes of the service. This plan has been generally adopted in electric light stations and in water supply stations, at least wherever the service is not given by the municipality. It seems to be the only just method of charging for the service whenever the importance of the installation warrants the increased complications of a service operated in this way. The measured service is just because then each person pays for his own use and does not have to bear part of the expense of serving his neighbor. It also prevents unnecessary use and waste, and in this way tends toward improving the service and reducing the cost of operation. This method of charging has been adopted for telephone systems in the large cities, with excellent results. We may cite as an instance the telephone service in and around New York city—undoubtedly the most important in the world—as a case where measured service has been adopted, completely to the benefit of the subscribers as well as of the company.

This being the case, it seems strange that a small number of telephone users in the city of Chicago should stand in their own light by opposing the introduction of the measured service there. Chicago generally manages to keep pretty well up in the procession. She is always one of the first to adopt improved

systems of doing things. She always has her eyes open for the best and is generally rated as what the newspapers would call a progressive city. Now, in this matter of telephone rates she does not wish to lag behind. The company and the large body of telephone users are in favor of a measured service. It is only a few of those who use the telephone who object to the improvement, but, as in the case of all public utilities, a few obstructionists can prevent, or at least considerably delay, any changes. It is to be regretted that the short-sighted subscribers can not see the matter in the proper light. Are they in favor of a system of charging under which they will be compelled to pay part of the expense incurred by their neighbors? If they are not, then how can they justify a system of charging under which their neighbors will be compelled to bear part of the expense of serving them? A measured service is the only just way of charging when the additional complications of giving such a service are not out of proportion to those of the simpler service and do not increase unduly the cost of operation. It is to be hoped that the few short-sighted telephone users of Chicago will soon be able to see the matter in the proper light.

TELEPHONE PROGRESS.

The rapid growth of the telephone industry is a continual source of surprise. Every year attention is called to the wonderful increase, and yet each succeeding year shows a growth so far surpassing preceding years that it is felt necessary again to comment upon it. For the year ending 1905 the growth was truly marvelous. Speaking roughly, the increase was nearly double that of the previous year. The increase each year is not only noteworthy, but the increasing rate of increase is a marked feature of the telephone business.

Statistics covering the telephone development throughout the entire country are unattainable because of the large number of independent companies which have no occasion to give out complete figures. One may, however, judge of the general telephone progress by studying the reports of the Bell companies. The annual report for the year 1905 of the American Telephone and Telegraph Company has just been issued, thus affording an opportunity of calling attention to certain significant features of the telephone industry.

The report states that the Bell companies had a total of 2,528,715 stations in service during 1905, as compared with 2,003,213 stations at the close of the previous year. This is an increase of over 525,000 stations, or over twenty-five per cent, as compared with the number of stations in service at the close of 1904. The increase during 1904 was 318,000—about nineteen per cent—while, as just noted, the increase for 1905 was over twenty-five per cent. The rate of increase is itself increasing, and this will probably go on until a considerably larger percentage of homes adopt the telephone. This increase is due to several things. Not only is the telephone becoming daily more indispensable in the home—it has already been recognized as an absolute necessity in the business world—but the telephone companies are studying the situation throughout the country. They are endeavoring to provide telephone service through the outlying districts as well as in the city, which will meet the needs of the different sections and will entail a cost commensurate with its use. In other words, the service is being fitted to the varying requirements of all sections, thus increasing its use far beyond that due to the increase in population or to a gradually growing appreciation of its usefulness.

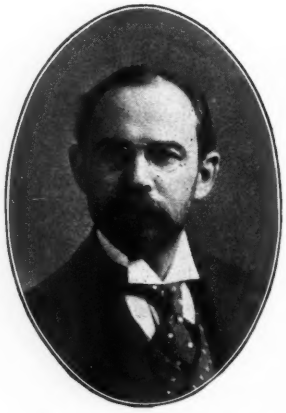
Another feature of telephone development—and though this is one which has been pointed out before, it is still worthy of comment—is the general tendency toward stronger and more permanent construction. This applies particularly to outside work. The tendency to-day is to place the wires underground whenever the importance of the installation warrants it, and, where conduits are not necessary, to use, as far as possible, overhead cables in place of the old-time wire construction. Underground work is, of course, immune from interruption by storm, and the overhead cable is much better able to resist a fierce blizzard or sleet storm than the many independent wires carried on one pole line. Freedom from interruption and general reliability are essential to any means of communication, hence the tendency to strengthen the outside plant.

Still another feature of telephone growth is the decreasing cost. Although the engineers will not allow any part of the plant to be scamped, the increasing use of the telephone—at least as shown by the reports of the Bell companies—is decreasing the investment per station. On the other hand, the increase in the number of stations involves an increase in the use of telephones which is more nearly geometric than algebraic, thus increasing the cost of operation, so far as handling the connections is concerned, more rapidly than the growth of the business. But constant improvements, as well as good planning for future growth, are having their effect, so that there is a general tendency to lower the rates. There are, of course, exceptions to this, particularly in some places where the rates offered in the first case were too low, due either to a false notion on the part of the management as to the cost of operation or in order to overcome opposition to the franchise.

The statistics showing the status of the Bell companies, although they give only a part of the actual work done in this country, are striking. They show that telephone service, although it is only thirty years old this year, has become one of the most important businesses in the country. During the past six years alone the Bell companies spent nearly $220,000,000 for construction and real estate, and this figure does not include the investment in long-distance lines, which up to the close of last year was approximately $34,700,000. The number of telephone stations has increased during these years from 675,761 to the present figure, 2,528,715. The total miles of wire is over 6,000,000; the number of employés is over 87,000; the number of conversations was over 4,479,000,000 during 1905, equivalent to fifty-four telephone calls for each man, woman and child in the United States. The average daily number of conversations was nearly 14,000,000.

Nominations for the Presidency of the American Institute of Electrical Engineers.

The directors of the American Institute of Electrical Engineers have placed in nomination for the presidency of the Institute, Mr. Edwin Wilbur Rice, Jr., Schenectady, N. Y., and Dr. Samuel Sheldon, Brooklyn, N. Y. Each of these gentlemen has been long and honorably connected with the electrical engineering fraternity and the membership of the American Institute of Electrical Engineers, and each has achieved that recognition as an exponent of the best thought and principles underlying development and progress in science and art which makes the selection of either for this high office an honor mutually to the institute and himself. Standing as each does at the present time at the focus of observation and consideration throughout the entire electrical field, a sketch of their careers is timely.



Mr. E. Wilbur Rice, Jr.

Mr. Edwin Wilbur Rice, Jr., is a conspicuous example of a man endowed with the characteristics of a successful modern engineer. Upon his graduation from the Philadelphia Central High School in 1880 Mr. Rice determined to follow experimental work, and associated himself with his former teacher, Professor Elihu Thomson, in a shop in Philadelphia. He accompanied Professor Thomson to New Britain, Conn., and later to Lynn, Mass. The years preceding the establishment of the Thomson-Houston factory at Lynn were filled with experimental research and work along lines in which Mr. Rice's inventive genius and constructive ability were given a wide field for action. When the plant at Lynn was established, his ability was recognized and he became the superintendent. When the union of the Edison and Thomson-Houston companies formed the present General Electric Company, Mr. Rice became prominently identified with the new corporation. The directive ability which had hitherto marked his work was given broader scope, and in 1893 he was appointed chief engineer of the company. Three years later, in addition to his duties as technical director, he was made third vice-president of the General Electric Company, and in that capacity has harmonized the technical and commercial interests of the business. Combined with the characteristics which have been mentioned, Mr. Rice has a remarkable intuitive understanding of men. This generalship and directive ability have enabled him to gather about him a most efficient corps of engineers, making for the success of the work he directs.

In the engineering world Mr. Rice has been associated with railway and lighting developments since their beginnings. More than a hundred patents have been granted to him in this country, and he has been foremost in the development of high-tension transmission work. The oil switch and the cellular method used in the installation and controlling of high-tension currents are notable examples of his work. In addition to his prominence in the affairs of the American Institute of Electrical Engineers Mr. Rice is a member of the American Association for the Advancement of Science, the American Society of Civil Engineers and of the Institution of Electrical Engineers, of Great Britain. After the Paris Exposition in 1900 he was created a chevalier of the Legion of Honor, and Harvard University in 1903 conferred upon him the honorable degree of master of arts.

Dr. Samuel Sheldon has long been known as an electrical engineer and educator, and as an indefatigable worker for the upbuilding of the American Institute of Electrical Engineers. He was born in Middlebury, Vt., March 8, 1862. He was graduated with the degree of A.B. at Middlebury College in 1883, and received the degree of A.M. in 1887. In 1888 he received the degree of Ph.D. from the University of Wurzburg, Germany. During 1884 and 1885 Dr. Sheldon was instructor of mathematics at Middlebury College. From 1885 to 1887 he was assistant to Kohlrausch, the distinguished physicist, at the University of Wurzburg, with whom he was associated in his celebrated determination of the ohm. He was assistant professor of physics at Harvard University from 1887 to 1889, and became professor of physics and electrical engineering at the Brooklyn Polytechnic in the latter year.

Dr. Sheldon has continued in practise as a consulting engineer, and has frequently been called upon to give expert testimony in state and federal courts. He has been the expert of the Swiss Department of Justice and Police since 1903, and is secretary of section B of the International Electrical Congress of 1904. He is a member of the International Electrical Jury of Awards of the St. Louis exposition. He is at the present time a manager of the American Institute of Electrical Engineers, a past-president of the New York Electrical Society, an honorary fellow of the American Electrotherapeutic Association, a fellow of the American Association for the Advancement of Science, a member of the American Physical Society, the American Electrochemical Society, the Society for the Promotion of Engineering Education and the National Electric Light Association. He is a prolific writer on engineering subjects, contributing liberally to the literature of electromagnetism, electrochemistry, alternating-current electrolysis, high-frequency phenomena, electrostatics, electromagnetic coulomb standards, and is the author of several well-known textbooks.

Dr. Samuel Sheldon.

The National Electric Company Sale.

The plant of the National Electric Company, including all assets, was sold at Milwaukee, Wis., on Monday, March 26, at auction to Charles L. Sullivan, of Chicago, Ill., for $500,000. Notice of protest against the terms governing the sale was filed by N. A. Christensen, who claims to control certain patents which are used in connection with the product. The National Electric Company was forced into bankruptcy following the defalcation of Frank G. Bigelow, formerly president of the First National bank, of Milwaukee. Mr. Bigelow was chief promoter of the company.

American Institute of Electrical Engineers.

The 205th meeting of the American Institute of Electrical Engineers was held at the Edison auditorium, New York city, Friday, March 23. The secretary announced the following directors' nominees to be voted upon at the coming Institute election:

President—E. W. Rice, Jr., Samuel Sheldon.

Vice-presidents—Frank G. Baum, H. H. Humphrey, A. H. Armstrong.

Managers—Paul Spencer, Paul M. Lincoln, J. J. Carty, A. M. Schoen.

Treasurer—George A. Hamilton.

Secretary—Ralph W. Pope.

Mr. T. C. Martin, chairman of the building fund committee, reported that up to date $132,389 has been subscribed toward this fund. Of this, $87,000 has been collected and placed in bank. The total amount which the Institute is endeavoring to raise is $200,000. One of the recent subscriptions was $1,000 from the Edison Electric Illuminating Company of Brooklyn.

The first paper of the evening was by Mr. J. B. Taylor, Schenectady, N. Y., entitled "Some Features Affecting the Parallel Operation of Synchronous Motor-Generator Sets." An abstract of the paper will be found on another page of this issue.

The second paper of the evening was by Mr. S. B. Storer, Syracuse, N. Y. It deals with the relation of the load-factor to the evaluation of hydroelectric plants. It shows how the cost of power varies with the load-factors and that therefore the latter really determines the value of any installation.

The third paper was by Mr. David B. Rushmore, Schenectady, N. Y., entitled "Notes on the Design of Hydroelectric Power Stations." Mr. Rushmore dwelt particularly on the influence of load-factor on the station design. He explained the usual conditions obtaining in hydroelectric plants, both hydraulic and electrical, took up the relation of station capacity to steam flow, and exhibited a large number of diagrams showing typical conditions. Curves were shown also which enable the most suitable equipment to be selected for any particular installation. A feature of hydroelectric plants is that each one presents a special problem—no generalizations can be made. The questions of the best efficiencies to select, storage capacity and of auxiliary plants and equipment were also dwelt upon.

Mr. W. L. Waters, Milwaukee, Wis., said that his personal experience with synchronous motor-generator sets convinced him that their operations were not so simple as one might be led to believe from Mr. Taylor's paper. He thought that it is simpler to start the machines by means of a direct-current set and synchronize at the proper moment in the usual way. Certain equipments with which he had had to do had given very satisfactory performance; others had always caused trouble, and the reason for this could not be given. One could never tell whether these units would go into phase properly or would only do so after considerable coaxing. The apparent lag due to the load, as indicated by the synchronoscope, was a source of danger. Mr. Waters thought that the method of bringing the generators into synchronism by slipping the poles on the motor was severe treatment and therefore undesirable. It must throw great strains on the windings of the machines.

In reply Mr. Taylor pointed out that when synchronous motor-generator sets are started from the alternating-current supply there is no alternative but to slip the poles of the machine in order to bring the generators into synchronism. This condition was always borne in mind and the machine built to stand it.

The meeting was then adjourned.

The National Electric Light Association.

The Trunk Line Passenger Association, the New England Passenger Association, the Southwestern Passenger Association, the Western Passenger Association, the Central Traffic Association and the Southwestern Excursion Bureau have authorized a rate of a fare and one-third from all points in their respective territories to Atlantic City and return for delegates and their friends attending the twenty-ninth convention of the National Electric Light Association, to be held at Atlantic City, N. J., June 5 to June 8.

Arrangements are being completed for an elaborate exhibit of apparatus by the manufacturers who are members of the association. Young's Pier has been secured, and it is stated that the illumination and general effects will far surpass any effort heretofore made.

In addition to a valuable programme of practical papers and a carefully arranged question box, there will be included many entertainment features which will make this convention one of the most attractive which the association has held.

Southern Bell Telephone.

The Southern Bell Telephone Company has increased the amount of its outstanding stock from $1,000,000 to $15,000,000. Stockholders of the company recently authorized an increase of the capital stock from $1,000,000 to $30,000,000. Out of this latter increase of authorized stock $14,000,000 has been issued, bringing the total outstanding up to $15,000,000.

The issue of the $14,000,000 of stock was rendered necessary by the rapid extension of the business of the Southern Bell Telephone and Telegraph Company. A territory of little promise developed into one of great value, and as in the case of the other rapidly expanding Bell telephone companies, a large floating debt was rolled up to provide new equipment and supplies. The money was advanced by the parent company, the American Telephone and Telegraph Company.

Civil Service Examination for State and County Service in New York.

The New York state civil service commission announces examinations to be held on April 14, 1906, for the following positions: architectural draughtsman, $15 to $25 a week; engineering examiner, state civil service commission, $1,500; first assistant physician, State Hospital for Tuberculosis, $1,500 and maintenance; inspector of gas and electricity, state commission of gas and electricity; medical superintendent, State Hospital for Tuberculosis, $3,500 and maintenance for superintendent and family; page and librarian, Westchester county service, $870; physician, Westchester county jail, $400; rod-man, state engineer's department, $3 a day; trained nurse, state institutions, $420 and maintenance; zoologist, state museum, $1,200; boiler inspector, department of public works, $3,000.

The last day for filing applications is April 9. Application forms and detailed information may be obtained by addressing the chief examiner of the commission at Albany, N. Y., Charles S. Fowler.

The Jamestown Tercentennial Exposition.

The House committee on industrial arts and expositions, Washington, D. C., on March 23 agreed to a recommendation for an appropriation of $1,480,000 for the Jamestown, Va., Tercentennial Exposition. Of this amount $250,000 is for buildings, $200,000 for exhibits and $100,000 for negro development.

The Jamestown exposition will be held at Hampton Roads, Va., next year, celebrating the 300th anniversary of the first English settlement in America.

PRESERVATION OF NIAGARA FALLS.

REPORT OF THE AMERICAN MEMBERS OF THE INTERNATIONAL WATERWAYS COMMISSION.

A report on Niagara falls, covering its present condition and what its future will be if there is no check upon the plans for the diversion of the waters for commercial purposes and recommendations as to legislation which should be enacted to insure the preservation of the glory of the falls, has been made by the American side of the International Waterways Commission to the secretary of war, who has transmitted the report to Congress. The Canadian members of the commission have agreed with all the statements of fact contained in the report, but as to the recommendation for legislation they asked for more time before concurring.

The commission, in discussing the value of the water power of the falls, says that it is very great, but takes the ground that if compared with values set aside by wealthy communities elsewhere for park purposes, the commercial value of the falls is not so great to be devoted to similar purposes. The report then merely adds that 800,000 visit Niagara falls annually. In discussing what legislation will be needed, the report says:

"If the falls are to be preserved, it must be by mutual agreement between the two countries. As a step in that direction, we recommend that legislation be enacted which shall contain the following provisions:

"The secretary of war be authorized to grant permits for the diversion of 28,500 cubic feet per second, and no more, from the waters naturally tributary to Niagara falls, distributed as follows:

"Niagara Falls Hydraulic Power and Manufacturing Company, 9,500.

"Niagara Falls Power Company, 8,600.

"Erie Canal or its tenants (in addition to lock service), 400.

"Chicago Drainage Canal, 10,000.

"All other diversion of water which is naturally tributary to Niagara falls to be prohibited, except such as may be required for domestic use or for the service of locks in navigation canals, suitable penalties for violation of the law to be prescribed. The foregoing prohibition to remain in force two years, and then to become the permanent law of the land, if in the meantime the Canadian government shall have enacted legislation prohibiting the diversion of water which is naturally tributary to Niagara falls in excess of 36,000 cubic feet per second, not including the amounts required for domestic use or for the service of locks in navigation canals. It is assumed, however, that an understanding upon this subject would be reached by treaty. The object of such legislation would be to put a stop to the further depletion of the falls, and at the same time inflict the least possible injury upon the important interests now dependent upon this water power.

"The amount to be diverted on the Canadian side has been fixed with a view to allowing to the companies on that side the amounts for which they now have works under construction, which are for the

"Canadian Niagara Power Company, 9,500.

"Ontario Power Company, 12,000.

"Electrical Development Company, 11,200.

"Niagara Falls Park Railway Company, 1,500.

"Welland Canal or its tenants (in addition to lock services), 1,800.

"One of the effects of such legislation would be to give to Canada the advantage of diverting 7,500 cubic feet per second more than is diverted in the United States. The advantage is more apparent than real, since the power generated on the Canadian side will to a large extent be transmitted to and used in the United States. In the negotiation of a treaty, however, the point should be considered.

"The substance of this report was submitted to our Canadian colleagues before the passage of the joint resolution, with a view to uniting in a joint report under the general law providing for the commission. There was a substantial agreement in the statement of facts, and such differences as developed with respect to the recommendations which ought to be made did not seem insuperable, but our colleagues desired time for further consideration. We have no doubt of their sympathetic interest in carrying out that part of the instructions contained in the resolution which requires us 'to exert in conjunction with the members of said commission representing the Dominion of Canada, if practicable, all possible efforts for the preservation of Niagara falls in their natural condition.'"

It is said that the recommendations of the commission granting the Chicago Drainage canal but 10,000 cubic feet a second will interfere materially with the plans of those in charge of the Chicago canal, who intend to make it something more than a mere drainage way. With no more than 10,000 cubic feet the drainage canal could not be enlarged.

In return for the impairment of the falls the report says that the state of New York will receive practically nothing for the 342,000 horse-power derived from authorized diversion of waters on the New York side, while the Queen Victoria Niagara Falls Park will receive an annual rental of $270,000 or an average of sixty-five cents per horse-power for the 415,000 horse-power authorized on the Canadian side of the falls.

According to the report, the total quantity of water to be taken from the river by works now authorized is 60,900 cubic feet per second. Of this amount 26,700 cubic feet are to be taken from the American side, and the remainder, 34,200 cubic feet, from the Canadian side. This means that twenty-seven per cent of the average discharge and thirty-three per cent of the low water discharge of the Niagara river will cease to pass over the falls when the works are completed and in full operation. The report continues:

"The quantity to be diverted is more than double the quantity which now passes over the American fall, which at the average stage is about 27,800 cubic feet. That this will in general have an injurious effect upon the falls seems self-evident. The volume of water to be diverted is about the equivalent of the entire discharge of lake Superior over the Sault Ste. Marie. The amount thus far actually diverted is but 17,800 cubic feet per second, and has had an appreciable effect upon the falls. To foretell with accuracy the effects in detail of the full diversion authorized would require a more complete knowledge of the bed of the river than is now obtainable. The water taken on the Canadian side below the crest of the rapids will affect the Horse Shoe fall alone. If all that taken on the American side should affect the American fall alone, it would practically leave it dry, but it seems probable that only a part of this diversion will be at the expense of the American fall.

"Exactly what portion that will be can not be stated with precision, but from a study of the channels and reefs so far as they are known a reasonable estimate is that the water would come from the two arms in about the proportion of one-sixth from the American falls and five-sixths from the Horse Shoe falls. Exactly what form the changes in the two cataracts will take, whether they will be made narrower or broken up into a greater number of streams, or simply be reduced in volume, retaining in general their present form, can not now be foretold, for the reason that there is no accurate knowledge of the form and depth of water on the crests. If 60,900 cubic feet per second be diverted the loss will be important, but if the diversion be limited to this amount or reduced, as hereafter indicated, it may not prove disastrous. This can not be definitely determined until the works now under construction have been completed and put in operation. When that happens, if it be found that the falls have not suffered serious damage as a scenic spectacle, it does not follow that additional water may be diverted with impunity. Additional diversion would be an experiment even more dangerous than that now being tried, and in our opinion should not be permitted."

Hohenfurth Plant in Bohemia.

By C. L. Durand.

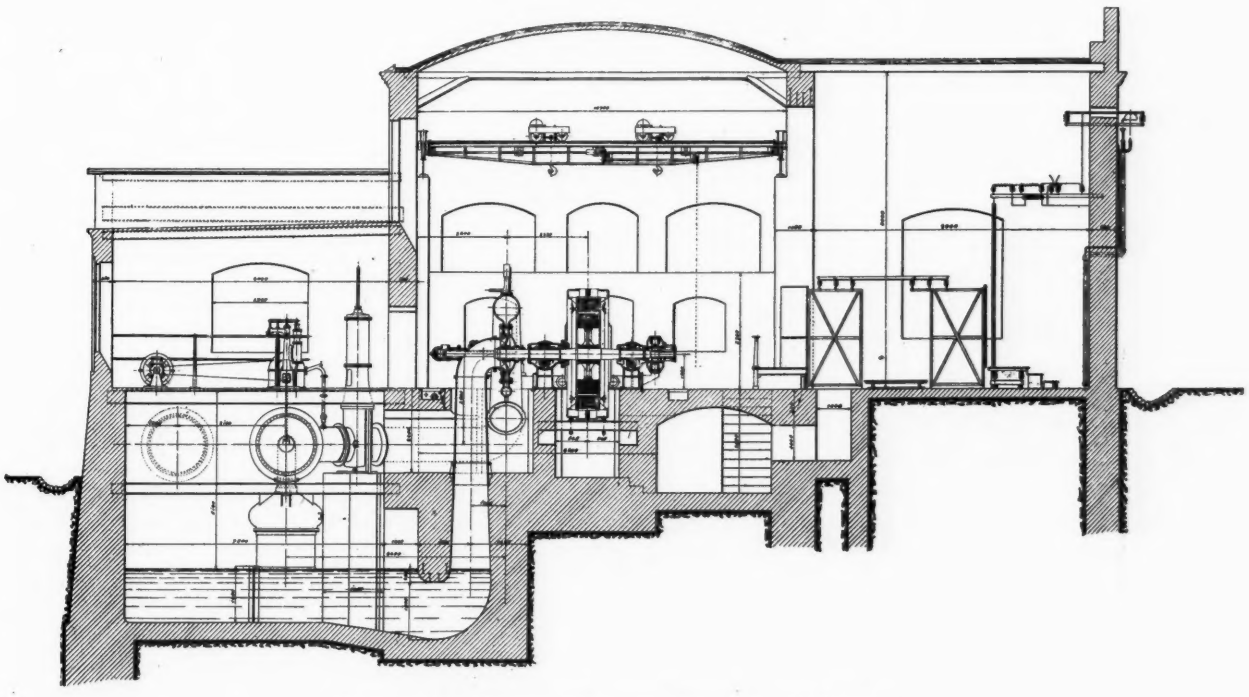
THE hydraulic station which has been recently erected on the Moldau river, in Bohemia, is the largest to be found in that region. Current is distributed from this plant by a high-tension line operated on the three-phase system throughout the surrounding region, especially to the town of Krummau, where a large amount is used in the paper-making establishments belonging to Ignaz Spiro & Sons. The hydraulic plant was, in fact, erected by the latter company, and most of the current is used in the two large paper factories, one of which lies within the town of Krummau and the second factory in the neighborhood at Pötschmühle. These two establishments are now equipped with a great number of electric motors and use about 2,500 horsepower in all.

The head of water which is given by the Moldau is exceptionally high, as it is some 315 feet and is thus to be ranked among the highest falls on the Continent. The present installation consists of the turbine plant, located near the river at Hohenfurth, a high-tension line running for fifteen miles and two substations at Pötschmühle and Krummau. The electrical outfit for the plant has been furnished by Ganz & Company, of Budapest. A dam of considerable size has been erected across the Moldau in order to secure the water supply for the hydraulic plant. The length of the dam is over 100 feet and it is of beton construction. It is provided with various gates and sluices for regulating the water level. From the dam starts the main water canal, which is somewhat over a mile in length and follows a slight down grade. The canal ends in a large water reservoir, which has been built to receive two penstocks. The water reservoir is divided into two parts, one side being used as a settling basin, while the other serves as the starting point of the two penstocks for the turbines. Only one of the penstocks is used at present, and the second acts as a reserve. The entrance of the penstocks can be closed off when need be, owing to the use of a special form of gate which slides back and forth upon rollers. This construction has been adopted owing to the high pressure, so that there will be but little friction in the system.

An electric water-gauge system has been adopted for the reservoir, so that the attendants in the turbine station can see the exact level of the water at this point. A float which is placed in the reservoir is made to operate a certain number of electric contacts corresponding to different levels, the contacts being spaced a few inches apart. In the turbine station is an indicating instrument which is operated by the above set of contacts and allows the water level to be read at this point.

The penstock which runs down from the water reservoir to the turbine is 1,830 feet long and is built of steel tubing having six feet diameter. The lower end of the penstock joins on to a separate distribution piping for the turbines, which is placed in a separate chamber of the building. The head of water measured from the level in the reservoir to the latter point is 313 feet. The penstock is provided with expansion joints and also with a set of air valves. To avoid shocks from the water a number of vertical air pipes have been placed on the penstock at a point near the reservoir.

An automatic pressure regulator for the water supply is used in the station. One of the engravings shows the general appearance of this device, and we also give a sectional view of the same. The regulator is placed in the annex chamber just over the end of the distribution pipe of the turbines. Its object is to provide an escape for the water at the end of the pipe, so as to relieve any extra pressure which might occur and thus keep the pressure on the turbines at a constant value.

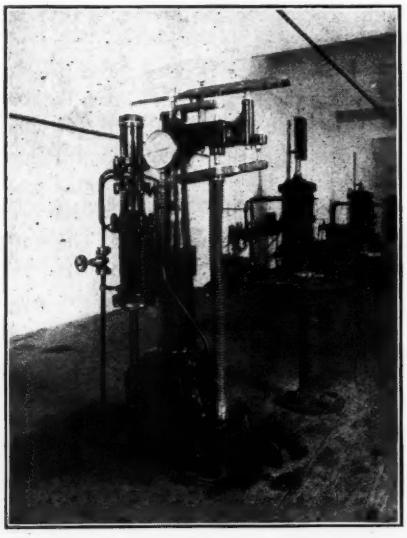


ELEVATION OF HOHENFURTH HYDROELECTRIC PLANT, BOHEMIA.

The action of the regulator is very simple. It consists of an overflow valve at the end of the pipe, which is connected by a long vertical rod passing through the flooring with the upper part of the regulator, which consists of a double-acting hydraulic piston operated in the usual way. By the water pressure upon the piston the rod and valve can be worked to open or close the valve in the piping. This action is carried out automatically and the water pressure is thus kept nearly constant.

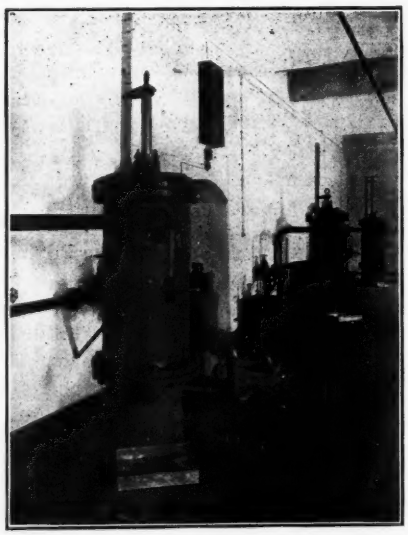
From the main distribution pipe a short branch leads to each of the three turbines. On each branch is placed the main gate of the turbine. A hydraulic device has been adopted for opening and closing the gates, and our engraving shows a view of the three apparatus which are mounted near the wall of the building. A hydraulic cylinder is mounted just above each gate and is connected to it by a long vertical piston rod, which passes above into the cylinder. Between the valve and the hydraulic apparatus is a large space, which is used as a stuffing box. By opening or closing a valve we admit the water pressure to one side or the other of the hydraulic piston and can thus operate the turbine gate as desired. In order to see the exact position of the gate the upper end of the piston rod is lengthened so as to pass outside the cylinder at the top, and it carries a pointer which works upon a vertical scale. The cylinders use oil under pressure, and a special valve is employed to admit the pressure to either side of the piston or to give a stop position in the middle. A hand pump is installed with the apparatus so as to act as a reserve, and by using a three-way cock we can connect the cylinder either with the oil-pressure piping or with the hand pump.

The three turbines which have been installed in the Hohenfurth plant are of the Francis spiral type and were supplied by Ganz & Company. They are designed to run on a full load of 2,500 horsepower under a 315-foot head of water, the normal speed being 420 revolutions per minute. The vanes of these wheels are movable, and they are operated by a system of levers, the latter being connected by a suitable transmission device with the hydraulic speed governor, which is provided for each turbine. The governor consists of a hydraulic piston apparatus, which is worked by a ball governor in the usual way, and oil under pressure is sent on either side of the piston. The oil-pressure system which has been installed in the plant is used for the governors as well as for the hydraulic pistons for operating the gates and the automatic outlet valve apparatus which we have just described. The oil pressure is given by a double-acting pump, which is direct-coupled to a small turbine in the station.



AUTOMATIC WATER OUTLET, HOHENFURTH HYDROELECTRIC PLANT, BOHEMIA.

The alternators which the station contains are three in number and they are direct-coupled upon the shafts of the Francis turbines, as will be observed in our engraving. These machines are of the three-phase type and are furnished by the well-known electrical firm of Ganz & Company, of Budapest. The alternators are of the most recent design and are constructed to carry a total load of 2,500 kilowatts with cos $\varphi = 0.7$. It is proposed later on to place two additional alternator groups of the same size in the station, and the foundations have been already prepared for these groups at the time of constructing the building. We may mention a few of the leading points about the construction of the new Ganz alternators, seeing that they embody several interesting features. They are of the twelve-pole type and are designed to generate three-phase current at 15,000 volts. When running at the normal speed the alternators make 420 revolutions per minute and the period of the current is forty-two cycles. An internal revolving field and an outer armature ring casting is used with these alternators. The external part forms a closed circular casting, and a pair of side brackets serve to bolt it down to a large foundation plate, which serves at the same time to carry the turbine. To the same foundation plate are fixed the two main bearings of the shaft. No special bearing is used in this case for the turbine, and this has the advantage of cutting down the friction loss, which is a considerable amount in a machine of this size. A thrust-bearing is carried on the outside of the turbine which receives the end of the shaft. On the outside of the alternator is carried a small exciter of circular form, which is held by a bracket against the main bearing.



HYDRAULIC GATE-OPERATING DEVICES, HYDROELECTRIC PLANT, HOHENFURTH, BOHEMIA.

The revolving field of the alternator is formed of an outer steel casting provided with twelve poles of round section, shrunk on to a central part or hub, which has a set of stout radial arms. On the field poles, which are comparatively short, is placed a magnet coil formed of a single flat copper strip winding. The strip is insulated at each layer by a thin insulation of high quality and is carried in an insulating spool which fits over the field core. Special care has been taken in this case to give the field magnet a very compact and solid form, so that the centrifugal force of the revolving part will not cause any damage to it. Pole-pieces of massive form are fixed to the outer face of the poles by means of four nickel-steel bolts. Current for the winding is brought as usual from a ring collector mounted on the shaft.

The outer armature of this machine consists of a main ring casting of considerable width, which is formed in two halves bolted together and is well stiffened by webs. It carries a good number of ventilating holes, which are placed in the middle part. This ring casting contains the laminated part of the armature, which fits into it in the usual way. It is built up of thin iron of the best quality. Each of the plates is punched with a set of oval holes near the inner side, so that when assembled they form a series of openings

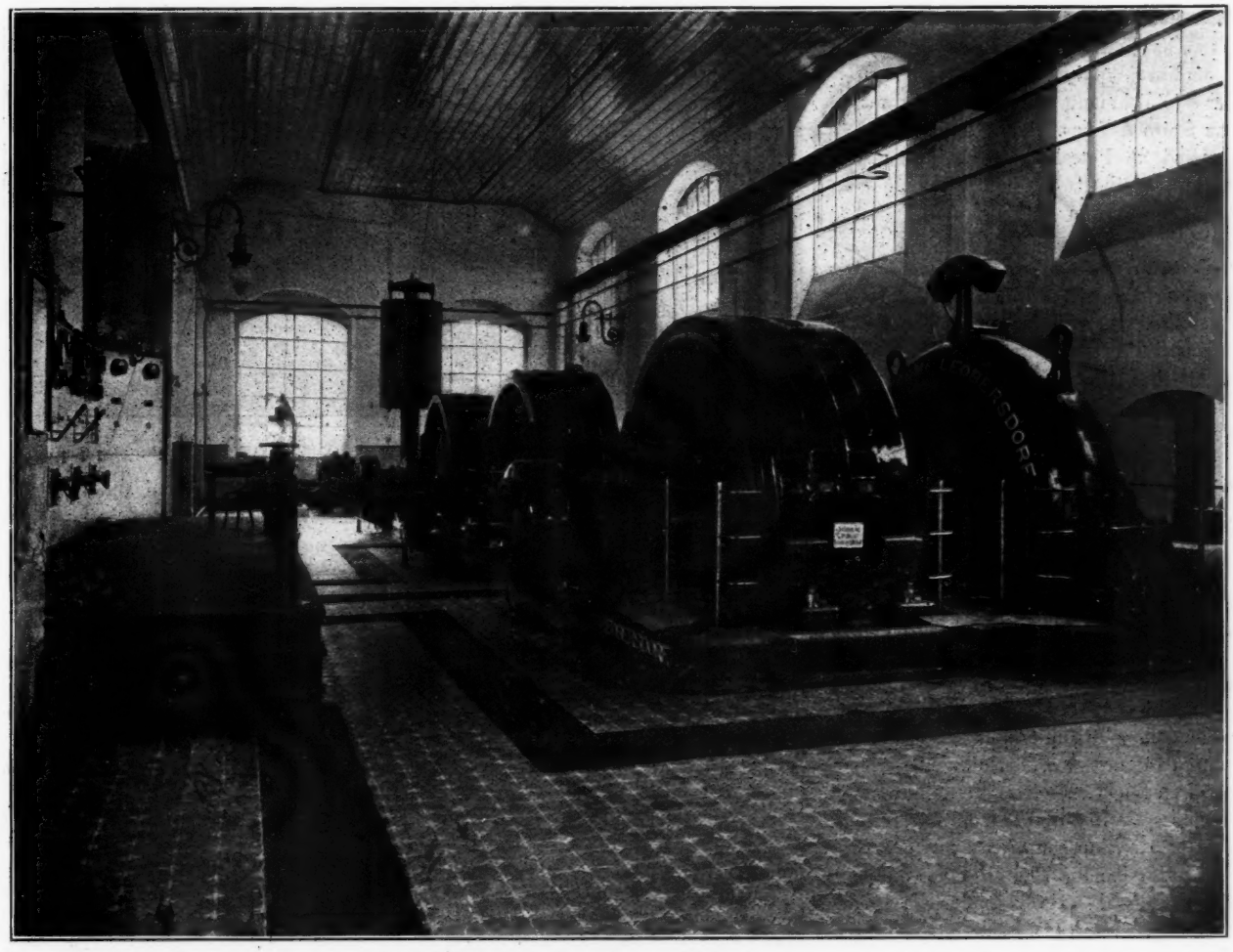
for lodging the armature coils. The holes are provided with mica tubes of oval section, and the winding is formed of insulated copper cable.

The station is provided with an extensive and well-planned switchboard system for the machines and the main circuits at high voltage which start from the building. First, we find a switchboard for the machines, containing the switching, measuring and regulating apparatus for each alternator, and second, a distribution board with measuring instruments and high-tension switches for each of the feeders. Both switchboards have been designed for the ultimate capacity of the station, and the machine switchboard has room for five alternators.

On the alternator switchboard we find a three-pole high-tension oil switch which contains several breaking points for each pole. The switch is placed on the back part of the panel and is operated from the front by means of rods and levers. Each of the machine panels is provided with a voltmeter, ammeter, three-phase wattmeter and an exciter voltmeter. A transformer is provided so as to use low-tension current on the instruments. For the parallel connection of the machines we have a phase-voltmeter and a lamp indicator. On the lower part of the panel is mounted a hand rheostat for the exciter current. In one of the engravings we show a view of the connections on the back of the machine switchboard.

The high-tension line which runs from the turbine station as far as the town of Krummau has a total length of about fifteen miles. It is formed of three copper wires having fifty square millimetres section. Treated pine wood poles are used for holding the line and at the top of the poles is a cross-arm of oak wood which has been treated with oil by boiling. The high-tension insulators are fixed to the cross-arms by steel bolts. These poles are, in general, about thirty feet high and are spaced from 100 to 120 feet apart. Special measures have been taken in order to secure a good protection for the line against lightning discharges. The method which is used in this case is to place a conical cast-iron cap upon the top of each pole, and the cap is provided with a projecting point, so as to attract the discharge. Connecting all the caps is a galvanized iron wire of small section which pass along above the high-tension line. At every third or sixth pole is a ground wire which is connected to the iron cap and runs down the pole to earth.

One of the accompanying views shows the interior of a substation which lies at the end of the high-tension line. There are two of these substations, which have about the same capacity and general arrangement. In these plants the main current of 15,000 volts is transformed to low-tension current at 300 volts. The two substations are located at Pötschmühle and at Krummau. In the middle of the station will be noticed the transformers, which are contained in large oil tanks with a good radiating surface. Around the walls we find the various apparatus for the primary and secondary lines. One point which we may mention here is the method

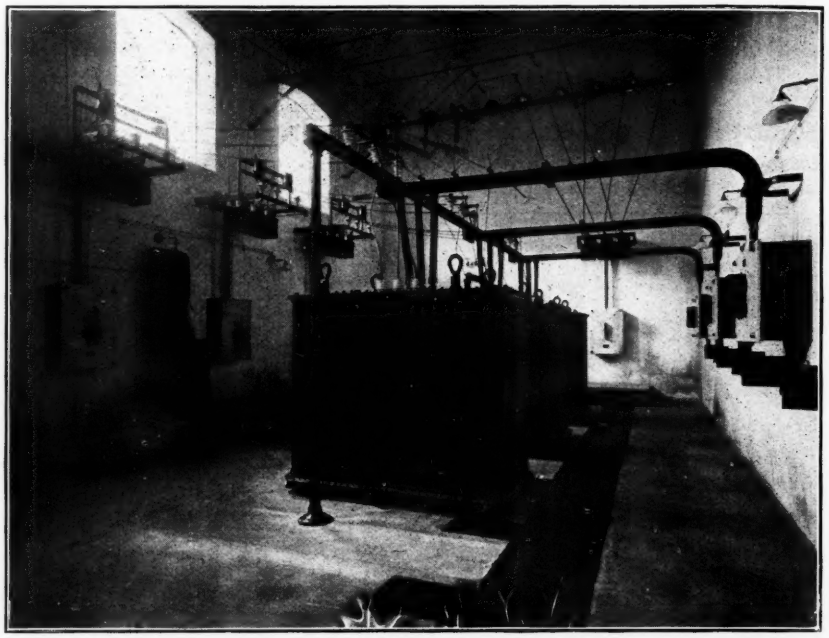


INTERIOR VIEW OF STATION, HOHENFURTH HYDROELECTRIC PLANT, BOHEMIA.

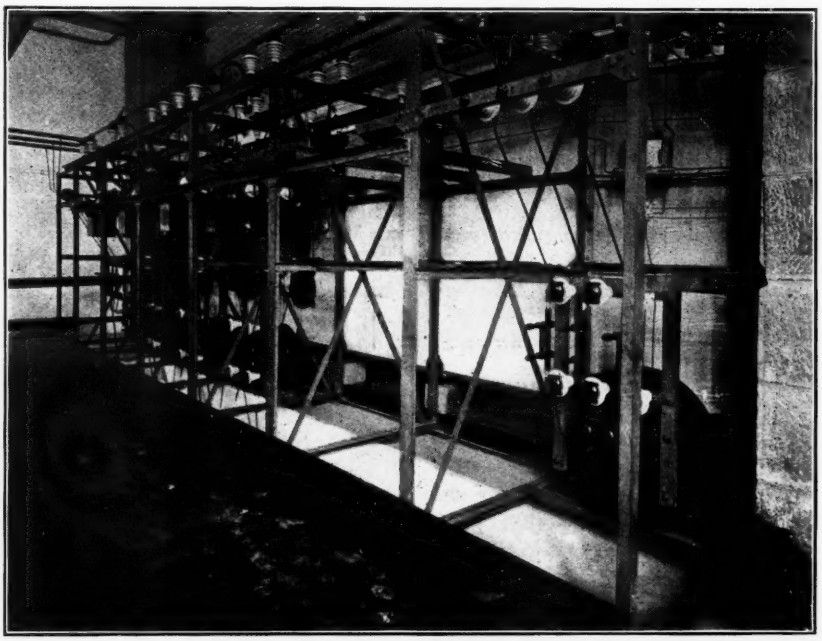
used for protecting the secondary lines, which are formed of heavy copper section. A copper fuse wire is placed for this purpose on the switchboard of the station, near the measuring and switching apparatus. Should a short-circuit take place on the secondary wiring, a set of high-tension automatic circuit-breakers which are mounted on the primary line comes into action and cuts off the current. A system of efficient lightning arresters is mounted both in the central station and the substation, and it affords a good protection to the apparatus.

As we have already mentioned, the high-tension lines supply current to two large paper establishments owned by the firm of Ignaz Spiro & Sons. The factory which is located at Pötschmühle is the more important of the two. Before the three-phase system from the hydraulic plant came to be used this factory used a number of steam engines to drive direct and alternating-current machines, and the latter supplied current for various motors throughout the establishment. Thus, we find at that time three single-cylinder steam engines having a total of 155 horse-power, which are now employed to drive three paper machines, also a two-cylinder 350-horse-power engine, a 150-horse-power engine of similar construction and a ninety-horse-power single-cylinder engine. Besides the former, we must include a 350-horse-power Laval steam turbine and a second turbine of 100 horse-power. Water power was also used in the factory, and was supplied from two turbines having a total capacity of 220 horse-power. The 350-horse-power steam engine was used on one hand to operate a transmission shafting and on the other to run a 300-kilowatt three-phase alternator. The current from the latter machine supplied a number of motors in the factory. The 120-horse-power engine was used entirely to drive a line of shafting, while the ninety-horse-power engine was coupled to a direct-current generator and also to an alternator. These latter machines served to supply all the lighting current for the works at Pötschmühle and also for the second factory at Krummau. As to the two steam turbines, they were coupled to three-phase alternators and the current from the latter went to supply various motors in the establishment. Some forty-seven motors were used in all, taking their supply from the three-phase machines. Their capacity varied from one to eighty horse-power, making about 770 horse-power as the total amount.

During the erection of the new hydraulic plant there were thirty-five new motors installed in the Pötschmühle works, having a total capacity of 830 horse-power. This was done so that when the current was supplied from the hydraulic station they could suppress most of the engines and also the two steam turbines. Another addition to the works comprised five electric motors, having a total capacity of 730 horse-power.



Interior View of Substation, Hohenfurth Hydroelectric Plant, Bohemia.



Rear View, Machine Switchboard, Hohenfurth Hydroelectric Plant, Bohemia.

The secondary circuits for the motor circuits had already been laid out for 300 and 100 volts and required massive copper bars having from 200 to 450 square millimetres section. These circuits were now to be supplied from the new transformer station, which we have already mentioned, lying alongside the factory. To carry the circuits over the public road, which lay between the two buildings, a strong bridge was erected and the copper conductors are laid upon it, being mounted upon stout porcelain cylinders carried in wood frames. The copper bars run from thence to the main switchboard of the factory, from which the circuits pass to each of the electric motors. A second set of conductors of 300 volts passes from the transformer station to the already existing

lighting switchboard, and here the current is transformed again to 100 volts by a set of small transformers for supplying the different lighting circuits.

The second paper factory, which is located in the town of Krummau, is of smaller size. It uses a principal motor of the 100-horse-power three-phase type, besides a twelve-horse-power motor in an annex building. A number of shafting transmissions are also driven by seven small three-phase motors having a total capacity of thirty horse-power. The wiring for these motors, which are operated at 300 volts, is run from the second transformer station near the premises. As to the total amount of power which is used in the two factories, the figure is quite variable, but on an average we may reckon it to be somewhere near 1,500 kilowatts in the first and 200 in the second factory.

Electric Traction on Swedish Railways.

A report has been published recently on the subject of utilizing Sweden's available water power for generating the electric power to be used on the railways. An abstract of this report is given in *Engineering* (London), March 9. The report is divided into three heads: first, the calculation of the number of horse-power required for traction of all Swedish state railways; second, the sections of railway suitable for electric traction, both theoretically and economically, and for the adoption of one of the systems officially tested; third, proposals for utilizing available water power in central Sweden.

As a basis for computing the total power required for the railways, the reports of the year 1903 are taken. The regular trains, it was found, required an aggregate average of 50,000 horse-power for sixteen hours out of the twenty-four. The maximum demand is estimated at from 150,000 to 200,000 horse-power. The price per horse-power-year, based on 150,000 horse-power, is placed at fifty kroner ($13.75) at the contact rail, making a total of about $2,120,000 for the electric power per year. The cost of the feeding lines, transformers, contact lines, etc., is estimated at $13,900,000, while the cost of maintenance and interest is put at $390 per kilometre, or a total of $1,390,000. The working expenses for the regular trains thus amount to $3,450,000, to which should be added $175,000 allowed for repairs to the electric locomotives, which brings the working cost up to about $3,750,000. Under the present system the total cost of operating by steam locomotives is about $1,870,000, which, in other words, means that the introduction of electric traction on all the Swedish state railways would result in an annual loss of $1,915,000, showing that electric traction for the state railways alone is economically impossible with existing systems.

Regarding the question as to which sections of the Swedish railways it might be profitable to transform into electric railways, it is held that the lines Storvik-Stockholm, Stockholm-Gothenburg and Katrineholm-Nässjö, with an aggregate mileage of about 560, possess the necessary technical and economic conditions for being advantageously worked with electric power, provided the difference between the average and the maximum power required, which is about 33,600 horse-power, can be disposed of for industrial or agricultural purposes.

The third section of the report deals with the utilization of the waterfalls of central Sweden—that is, the falls of the Göta, the Dalar river, the Svart river, the Let river and the Motal river, which probably represents an aggregate power of 187,000 available horse-power. It is proposed to run a transmission system at from 40,000 to 60,000 volts as a primary line from Gothenburg to Stockholm, from the Motal river to the Dalar river, and from the latter river to Stockholm, the large waterfalls of Trollhättan and Alfkarleö becoming the main sources of power. At about ten miles distant from each other the secondary lines are to proceed from the main line, which secondary lines, through transformers at the junctions, will receive a current of about 6,000 volts, and which will not only pass through thickly settled districts with towns and many industrial centres, but will also touch the private railways of the districts in question, of which there are about 600 miles in Sweden.

The aggregate length of the primary line as proposed is about 940 miles, and there will be a reserve line of the same length. There will also be 941 miles of the 6,000-volt secondary lines and about 1,250 miles of contact lines. The cost of these lines is approximately estimated at $23,500,000, including the transformer stations. The annual maintenance of both is placed at $360,000; interest and transfers to sinking fund at $1,515,000, and the cost of the water power itself (thirty kroner per horse-power at the falls) at $1,315,000, the annual expenditure thus being about $3,200,000.

At the present time it is impossible to make any definite estimations of whether the system would be profitable, but it is thought that neither the state nor the private railways would object to securing the rolling stock for electrical operation, provided the working expenses were no higher than is now the case. It is also proposed that the towns and municipalities touched by the secondary lines should contribute toward the interest and sinking fund for the cost of subsidiary installations.

It is estimated that as against the cost of maintaining this system the state and private railways might be charged $1,590,000 per annum, leaving $1,610,000 to be covered by other users of electricity. There would be available about 100,000 horse-power, the average consumption of the railways being put at 30,000 horse-power, which allows for losses in transmission, maximum requirements, etc.

The advantages of this system are said to be the reduction by about $830,000 of the imports of coal and the supplying of towns, agricultural districts and industrial concerns with cheap light and power.

Wire Trust in Belgium.

Consul McNally, of Liege, says that five of the largest wire manufacturers of Belgium have entered into a syndicate agreement to control the markets of Belgium and Holland. Quite recently their sphere of action has been extended to include the European countries by reason of a failure to reach an agreement with the German manufacturers, because of their demand of the lion share of the orders. This agreement is subscribed to by the five manufacturers, and a violation of any of its covenants is met with a fine of $10,000. It is said that all orders received are forwarded to the syndicate's principal office, at which place the orders are divided. The agreement is to remain in force and effect for three years unless the same is abrogated by a majority of the contracting parties. The competition with the German makers is keen. It is said that the German manufacturers receive from the government a sort of subsidy on all orders intended for export, and that with this assistance they are enabled to cut under the ruling price in foreign markets. It is thought that this trust agreement will not be long lived.

Texas Independent Telephone Association.

The Independent Telephone Association, of Texas, will meet at Waco, Tex., April 25-27. Mr. J. B. Earle, secretary of the association, has issued a call for this purpose, and the local committee will begin work at once to make the meeting a success.

SOME NOTES ON MOTOR DRIVING.[1]

BY W. J. BELSEY.

A problem which almost invariably confronts us in the laying out of an electrical drive is to determine whether the machines should be driven individually or in groups, and unless one has a most intimate knowledge of the working conditions which obtain, it is most difficult to say which is the best. As a general rule, individual driving is about fifty to sixty-five per cent greater in the first cost than group driving. The advantages of individual driving are well marked, in that each machine is an independent unit and can be run without respect to the other machinery. The liability to break down is considerably lessened, and full advantage can be taken of the stops or intermittent working of the machine, current being only taken when the machine is in use and only in proportion to the work done. The advantage of a group drive is principally in the low first cost. In the majority of cases, however, the problem resolves itself into a compromise, the larger machines being driven by individual motors and the smaller ones grouped together in small groups driven from short lines of shafting. The question of a proper grouping is one which merits very serious consideration, as on it very often depends the financial success of an installation. So many local and special features, such as the shape of the building and the position of the machinery to be driven, play a most important part in this question, that it would be futile to attempt to deal with it in detail, but the author may mention one instance which came under his notice where, in a furniture factory, by the rearrangement of the groups already driven by motors, a saving of $435 per annum was effected in the current bill with an outlay of only $245.

SPINNING MILLS.

One of the most essential conditions for the operation of all classes of preparing and spinning machinery, whether cotton, flax, jute or wool, is a predetermined constant speed. The rate of production of a given frame is governed by the number of broken ends which occur, and which can be picked up by the operator in a given time. The causes of these broken ends are: (1) irregularity of speed; (2) inequalities in the fibre; and (3) as an absolute limit the centrifugal force the fibre will withstand. From the above it will be apparent that an induction motor is undoubtedly the best suited for the operation of spinning frames, for its speed with a given load is constant with respect to the speed of the prime mover, and as the load on spinning frames varies but slightly whether empty or full, it may be said that if driven by an induction motor the speed of the frame will be constant with respect to the speed of the prime mover. The speed of a shunt-wound direct-current motor is not by any means solely dependent upon the speed of the prime mover, for it varies, depending upon whether the motor is hot or cold, and the difference in speed with a continuous-current motor, cold and hot, is generally about five to ten per cent, say eight per cent as a fair average, and it takes from two to four hours (depending on the size) for a motor, starting cold, to reach its maximum speed. This means loss in production. Of course, these difficulties could be overcome if we fixed shunt regulators on to the motors and generators, but if the mill manager did this he would be taking the production out of the hands of the management and giving it to the operators, which, to say the least, would be unwise, and a condition which no mill manager would consider for a moment. Again, the atmosphere of a spinning mill is invariably charged with fine lint dust and fibre, which has a most deleterious effect on the commutators of direct-current machines, and this in itself is sufficient to preclude the adoption of direct-current machines for this class of work. Also, as every available square foot of floor space is occupied by producing machinery, the motor is generally located either on a platform hung from the ceiling, or is bolted direct to the ceiling in an inverted position.

A group system of driving is generally adopted for spinning mills. The motor is usually of a large capacity, ranging from seventy-five horse-power to 150 horse-power, and is direct-coupled to the line of shafting, from which are driven a number of machines by means of belts. The over-all efficiency of this method is equal to that of the individual drive, notwithstanding the use of belt transmission to the individual machines. This is due to the much higher efficiency of the larger motors, as compared with the efficiency of the smaller motor used on the individual drive system. A disadvantage of the group system, however, is that it is practically impossible to vary the speed of the individual frames while they are in operation. The same remarks as to the suitability of alternating-current induction motors apply in a somewhat lesser degree to the other operations in a spinning mill, such as carding, breaking, hackling, spreading, etc.

WEAVING.

In weaving it is essential to have a maximum fixed speed, and this speed is fixed by the strength of the yarn and by the liability of the shuttle flying. In this case, again, an induction motor shows itself to be best suited for the driving of looms for the very same arguments which are advanced for spinning. It is a general rule to drive all weaving machinery in groups off short lengths of shafting. The power required by a loom is comparatively small, varying from about one-quarter horse-power in the ordinary looms to about two horse-power in the very heavy carpet looms.

BLEACHING, FINISHING AND TEXTILE PRINTING.

In these factories we find that it is desirable and convenient to have at our disposal an economical method of varying the speed of some of the machines we purpose driving, and as these machines are the largest power users in these works, continuous-current motors are undoubtedly the best suited for their operation. Moreover, the machines in these factories do not require, either for their output or finished product, the refinements of speed which are necessary in spinning and weaving, and a variation of speed of eight per cent does not affect them materially. As to the particular type of continuous-current motor used on the most important machines, we will deal with these as follows:

CALENDERING MACHINES.

Calendering machines require, according to size, motors from twelve horse-power to fifty horse-power, and these are generally individually driven, the motors being spur-geared to the machines. The motors should be capable of giving a speed variation of, at least, two to one on the shunt. The load on these machines is very heavy at the start, owing to the friction of the long train of gearing and the heavy cylinders, and it is generally figured that they take from one and one-half to two full-load torque at starting.

DYE JIGS.

Dye jigs are generally driven in groups of from ten to twenty, as the power taken by each only averages about one-half horse-power. The starting effort is very light, therefore a shunt-wound motor is quite suitable for driving these machines.

STENTER, OR DRYING AND STRETCHER FRAMES.

These machines consist of two members, the one being a fan and the other

[1] Abstract of a paper read before the Dublin local section of the Institution of Electrical Engineers of Great Britain, on February 8.

for stretching and drawing the cloth over the hot-air vents. It is usual to operate them by two motors—one for driving the fan and the other for operating the drawing and stretching mechanism. The load at the start being comparatively light, shunt-wound motors are used for both members. It is preferable that the motor operating the drawing mechanism should be capable of a speed variation of about two to one, as according to the texture of the cloth the drying can be done rapidly or slowly.

BEETLING MACHINES.

These machines are generally driven in groups, each beetle taking about ten horse-power. The machines are heavy at starting, and, therefore, compound-wound motors should be used.

CALICO-PRINTING MACHINES.

Calico-printing machines are generally individually driven, owing to the intermittent nature of the work, and the motors are generally of fairly large capacity—from twenty horse-power to forty-five horse-power. The motors should be compound-wound, and it is very essential to have an economical range of speed variation of about three to one.

ENGINEERING WORKS AND FOUNDRIES.

On the whole, the author thinks that the continuous-current motor is the best suited for the work, as variable speed may be desired, and is in some cases essential. It may be taken as a fair general rule that in an engineering works it pays to drive any machine requiring over five horse-power individually.

A few tables as to the size and rating of motors used on the various machines in general use in engineering works may be of interest, and the author, therefore, gives the same below:

LATHES FOR SCREW-CUTTING AND GENERAL WORK.

Height of Centre. Inches.	Distance between Centres. Inches.	Rating of Motor. B. H. P.
4½ to 6	20 to 32	¼
7 to 8½	36 to 80	½
8½ to 12½	40 to 100	1
14 to 16½	100 to 140	1½
16½ to 19	140 to 175	2

FACE LATHES.

Diameter of Face-Plate. Inches.	Largest Working Diameter. Inches.	Rating of Motor. B. H. P.
36 to 50	48 to 64	2
60 to 68	64 to 98	3
80 to 100	106 to 140	5
158	212	10

TURRET LATHES (WORKING WITH ONE TOOL).

Height of Centre. Inches.	Largest Working Diameter. Inches.	Greatest Work in Length. Inches.	Rating of Motor. B. H. P.
9	20	33	1
11½	24	43	3
11¾	25½	33	2
13	28	55	5
16¾	34	63	5

VERTICAL BORING MACHINE.

Diameter of Table. Inches.	Greatest Working Diameter. Inches.	Rating of Motor. B. H. P.
50	51	2
68	84	3
82	96	5
83	120	5
156	300	15

HORIZONTAL BORING MACHINES.

Greatest Height of Bar. Inches.	Largest Working Length. Inches.	Rating of Motor. B. H. P.
21 to 25	40 to 60	1½
33 to 35	80 to 140	2

DRILLING MACHINES.

Pattern.	Maximum Diameter of Work on Table. Inches.	Greatest Distance from Spindle End to Table. Inches.	Rating of Motor. B. H. P.
Quick speed...	6 to 10	9 to 35	½
Pillar.....	10 to 13	32 to 48	1
Radial.....	40 to 72	46 to 80	2
Three-spindle.	6 to 6	31 to 35	1

MILLING MACHINES.

Pattern.	Dimensions of Table. Length. Inches.	Dimensions of Table. Breadth. Inches.	Greatest Distance from Spindle to Table. Inches.	Rating of Motor. B. H. P.
Universal (medium)....	30	5	12	1
Ditto (heavy)..	58	11	22	1
Vertical and Straight...	70	14	22	3
Ditto	120	52	44	5

Wheel-cutting machine for wheels of 20 in. to 48 in. diameter, 2 B. H. P. Ditto for wheels up to 55 in. diameter, 3 B. H. P.

GRINDING MACHINES.

Diameter of Emery Wheel.	Rating of Motor.
Up to 10 in.	½ B. H. P.
10 in. to 14 in.	1 "
14 in. to 22 in.	2 "

PLANING MACHINES.

To Plane in Length. In.	To Plane in Width. In.	To Plane in Height. In.	Rating of Motor. B. H. P.
40	26	26	1
72	24	24	1½
84	26	24	3
120	38	38	5
120	49	49	7½
168	60	60	10
192	73	73	10
200	105	105	10

SHAPING MACHINES.

Length of Stroke. Inches.	Traverse of Head. Inches.	Greatest Distance from Underside of Ram to Table. Inches.	Rating of Motor. B. H. P.
4½	15	8	½
16	30	20	1
20	20	20	1
25	25	26	1

SLOTTING MACHINES.

Length of Stroke. Inches.	Width of Slot. Inches.	Depth of Slot. Inches.	Dimensions of Table. Inches.	Rating of Motor. B. H. P.
5	14	12	12 × 12	½
6	12	9	20 × 16	1
8	20	24	dia. 28	1½
8	30	30	dia. 30	1½

DROP HAMMERS.

Weight of Tup. Lb.	Largest Drop. Inches.	No. of Strokes per Minute.	Rating of Motor. B.H.P.
330	44	153	7½
550	50	126	7½

PNEUMATIC HAMMERS.

Weight of Tup with Piston. Lb.	Length of Stroke. Inches.	Number of Strokes per Minute.	Maximum Height of Work. In.	Rating of Motor. B. H. P.
165	11¾	220	4¾	3
275	14½	200	7	4½
440	17¼	180	8¾	6½
660	19	170	10¼	8
1,000	21½	150	11¾	10
1,425	23	130	13¾	12-15
1,870	27	110	15¾	17-20

In foundries all the conditions which obtain are such that make it desirable to use induction motors. None of the machines used in a foundry requires a variable speed; also the atmosphere is charged with a gritty dust, which acts very deleteriously on the commutators of direct-current motors.

PUNCHING AND SHEARING MACHINES.

Undoubtedly, for punching and shearing machines, induction motors are the best suited, principally on account of their very robust construction and also because an induction motor can exert a much higher torque than a direct-current motor when suddenly required—as in the case of the actual moment of shearing and punching—without an appreciable variation of speed. The speed of punching varies from about twenty-eight strokes per minute in the larger punches for one and one-half-inch-thick plates to about forty strokes per minute in the smaller ones, three-quarters-inch plates. It is not generally considered good practice to exceed these speeds, as, if higher are used, the squad just misses a stroke, and therefore reduces the actual speed of punching by half. If direct-current machines are used, they should be compound-wound. Angle cutters and beam punches all have the same characteristics as the above.

PLATE ROLLS.

For plate binding rolls and mast rolls the motors should have the same characteristics as a railway or crane motor—*i. e.*, they should be series-wound and be capable of exerting a high torque when required. Plate roll motors are generally fitted with a brake attachment for convenience of adjusting the rolls. Although the series motor is undoubtedly the best suited for this class of machine, yet induction motors have been used with very considerable success for driving them, and on the northeast coast nearly all machines are driven by three-phase motors.

PLATE EDGE PLANERS AND SCARFING MACHINES.

These machines are generally driven individually, and neither alternating-current nor direct-current motors have any special advantage. If direct-current motors are used they should be compound-wound, as these machines take a considerable amount of power at the reverse.

COUNTERSINKERS, RADIAL DRILLS, ETC.

Most machines, such as these, are generally driven in small groups, and either alternating-current or direct-current motors would do equally well for driving them. There is nothing very special about a group drive of this description, and a shunt-wound motor would be quite suitable.

IRON AND STEEL WORKS AND ROLLING MILLS.

A brief description of a method for driving a set of three mills may interest you, and from this you will see the general conditions affecting the driving of rolling

mills electrically. Assume the total estimated power required for three mills is about 1,200 kilowatts, the power would vary between that amount and the energy required to drive the mills light. Assume the generating station has a capacity of 2,250 kilowatts. This would be subjected to sudden shocks of the above magnitude unless some method of compensation is used. These sudden shocks would, of course, affect the regulation of the system to a serious extent. If this is to be obviated, some device for storing and giving out energy must be resorted to. This can be done in two ways: first, by having a battery of accumulators, or, second, by having a buffer machine for storing the energy in a heavy flywheel. This latter device has been adopted in some mills, and has been found to be both cheaper and more efficacious than the former. As stated above, the maximum total power required by the three mills equals 1,200 kilowatts, but the mean power only equals 300 kilowatts, and, therefore, the buffer machine will have to supply for the short periods the difference between these amounts—namely, 900 kilowatts. This buffer machine consists of a dynamo having a variable speed from 250 revolutions per minute to 500 revolutions per minute, and upon the shaft of which is fitted a flywheel having a weight of about twenty tons, and a peripheral velocity of 212 feet per second when revolving at 500 revolutions per minute; therefore, at that speed the storage of energy is 14,000 foot-tons, and if the flywheel is reduced in a speed from 500 revolutions per minute to 250 revolutions per minute, the capacity of the flywheel is 14,000 minus 3,500 equals 10,500 foot-tons. If we assume a total loss in this buffer machine of fifteen per cent, including friction and all electrical losses, then the power available in the flywheel equals 27,500 horse-power-seconds or 21,000 kilowatt-seconds; therefore, it will be seen that the buffer dynamo will give 21,000/60, equals 350 kilowatts for one minute, 700 kilowatts for half a minute, and so on. In actual practice, however, the pulsations of load will only last a few seconds, so that the flywheel will never be greatly reduced in speed.

A sketch is given (Fig. 1) showing diagrammatically how this machine is arranged, and from this you will see that a small motor-generator supplies the excitation for the buffer dynamo. The generator for this set is usually excited by

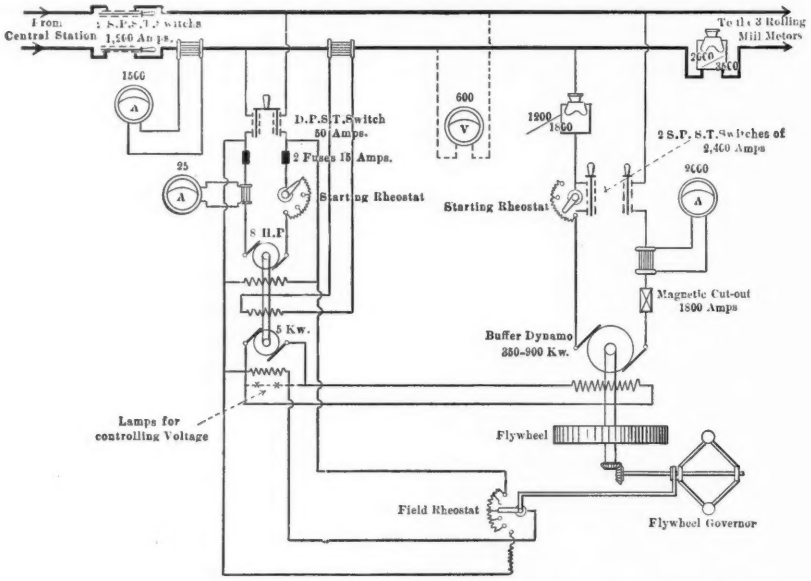


FIG. 1.—DIAGRAM OF CONNECTIONS FOR ELECTRICAL CURRENTS SUPPLYING POWER TO THREE ROLLING MILL MOTORS.

part of the current flowing from the generating station to the rolling mill, or perhaps a better way to put it would be that it has a shunted series winding, so that as the load increases the voltage of the exciting generator increases. By this means the excitation of the buffer dynamo is changed, which, in its turn, causes a corresponding change in speed, and corresponding to this decrease or increase in speed the buffer dynamo runs as a generator or as a motor.

PAPER MAKING.

Paper-making machinery largely exhibits the characteristics of bleaching and finishing machinery, inasmuch that it is essential to have a wide range of economical speed control, and, therefore, continuous-current motors are generally used. Excepting in one or two instances, all the machines in a paper mill are individually driven, and it is a class of work which very readily and economically lends itself to this system, as the power required by each machine is generally fairly large and the work intermittent. In the majority of machines the load is of a variable character and liable to sudden shocks, and therefore compound-wound motors should be used.

PRINTING MACHINERY.

In the application of motors to the driving of printing machinery we have what may be considered one of the most interesting fields for the application of electricity, and one where electrical driving has shown itself to be preeminently the best over all other methods. The question of driving printing machines is very complex, owing to the large range of speed which the printers require to have at their disposal, and, therefore, printing machinery is generally operated by direct-current motors if the best and most economical results are to be obtained, and, even if an alternating-current supply were available, it would probably be best to convert it to direct current. For linotype and small jobbing machines of the stop-cylinder or flat-bed type, these are best to be arranged in small groups, so that each group may be driven from a short length of shafting. Owing to the rapid fluctuation of power required by all machinery having a reciprocating motion, and more especially flat-bed machines, it is desirable to use compound-wound machines. For guillotine shears and other machines of the same nature, the motor should be heavily compounded. The medium-sized presses are generally individually driven, the motors having a variable speed of about two to one on the shunt. For very large presses provision has to be made for obtaining very slow speeds economically, such as when the paper is being threaded in or backing up and making ready for a run.

Northwest Illinois Telephone Systems Unite.

An organization was effected at Galesburg, Ill., on March 15, by sixteen independent telephone systems in the northwestern part of Illinois for the purpose of cooperating with other independent district organizations of Illinois. Among the cities included are Galesburg, Burlington, Canton, Kewanee, Monmouth, Macomb and Aledo. The following officers were elected: president, W. J. McQuiston, Monmouth; vice-president, C. M. Erwin, Macomb; secretary-treasurer, R. G. Roadstrum, Galesburg. Measures were taken to make the various toll lines standard to connect with systems of other districts and to promote a central clearing house.

ANNUAL REPORT OF THE DIRECTORS OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

STATEMENT BY PRESIDENT FREDERICK P. FISH FOR THE YEAR ENDING DECEMBER 30, 1905.

The annual report of the American Telephone and Telegraph Company for the year ending December 31, 1905, as presented by President Frederick P. Fish, for the directors, reveals a very satisfactory condition, gains being recorded in every direction. The following extracts are taken from the report:

"The net output of telephones during the year 1905 was 1,217,694, making the total number in the hands of the operating companies 5,698,258.

"The number of exchange stations at the end of the year operated by the companies which constitute the system in the United States was 2,241,367, an increase of 441,734. In addition to this number there were 246,337 exchange and toll stations operated by so-called sub-licensees, namely, independent companies or associations under sub-license or connection contracts and making use of the telephones. Adding also the telephones employed for private-line purposes, the companies had a total of 2,528,715 stations as against 2,003,213 stations at the close of the previous year.

"The total mileage of wire in use for exchange and toll service was 6,043,518 miles, of which 1,372,480 miles were added during the year. These figures do not include the mileage of wire operated by sub-licensees.

"Including the traffic over long-distance lines, but excluding sub-licensees, the daily average of toll connections was about 368,000, and of exchange connections about 13,543,000, as against corresponding figures in 1904 of 301,000 and 11,149,000; the total daily average for 1905 reaching 13,911,000, or at the rate of about 4,479,500,000 per year, being fifty-four telephone calls for each man, woman and child in the United States.

"The amount added to construction and real estate by all the companies, excluding sub-licensees, constituting the system in the United States during the year 1905, was:

For exchanges	$36,771,312
For toll lines	9,832,204
For land and buildings	4,177,390
	$50,780,906

"The amount added in 1900 was $31,619,100; in 1901, $31,005,400; in 1902, $37,336,500; in 1903, $35,368,700; and in 1904, $33,436,700; making the grand total of expenditure upon these properties during the six years $219,547,306.

"The amount expended by the company in 1905 for the construction, equipment and supplies required for its long-distance lines was $3,805,053, making the total investment in long-distance lines and equipment, up to the close of the year, $34,694,763.

"The growth of the business during the past year has been greater than ever before. There is no doubt that the business will continue to increase. The use of the telephone is extending more and more in every section of the country and in every class of the community. It is revolutionizing business methods and social relations to a substantial extent.

"The added experience of each year shows more clearly what are the specific requirements which must be met in order to make the telephone system as useful as possible. It is the effort of the Bell companies to adapt the service to the demands of large and small users, business and residence, in large and small cities, rural towns and country districts of various kinds, and to devise and introduce rate schemes that will fit the many and diverse conditions with which the companies are confronted. In pursuance of this policy, combinations of individual and party lines have been introduced; special equipment has been devised for hotel, department store, apartment house and private branch exchange service; prepayment coin boxes, public pay stations and special farmer and ranch line service have been provided, in each case with suitable rates adapted to the user and to the service. The enormous growth of the system during the past few years would have been impossible if the utmost attention had not been given to the differentiation required for such varied uses. Every year it becomes more clear how best to meet the needs of the public, and it is in large part because we are better able to fit the service to the varying requirements and thus broaden the field of use, that the demand for telephone service and the extent to which the service is used is increasing far beyond any increase that is due to the development of population or the expansion of business and social activity. Everything that makes the service of greater value, in and of itself accelerates the rate at which the business will grow, and outside of improvements in the service itself, which have been and are constantly effected, there is nothing which adds so much to the value of the service to those who employ it as the increase in the number of subscribers and the extension of the service into every field.

"On the executive and business side there has been a development equally on right lines. It was and is a definite advantage that the control of an enterprise extending throughout the United States was not so definitely centralized as to prevent local initiative and an obligation on the part of competent men in each section of the country to grapple on the spot with the peculiar problems which each locality has developed. The country is covered by the associated operating companies, nearly forty in number, each having its own trained officials in every department and its own board of directors, made up of men of standing in their respective communities, who know and sympathize with the needs of those communities. In this way many of the great problems of the business, including the greatest of all problems, that of rates, which was discussed to some extent in the last annual report, have been studied and dealt with practically by a large number of organizations, each in touch with the peculiar conditions of its own locality, but all so related as to give to each the benefit of the views and experience of the others. While many problems are still unsettled and new ones arise every year, great progress has been made toward the establishment of sound views as to the way in which the business should be handled so as to give satisfactory service everywhere and to all classes in the community at as reasonable rates as are consistent with the maintenance of good service and with the development of the business on safe lines. There is, every year, a better understanding on the part of our companies with the communities in which they respectively work, the companies appreciating more clearly the needs of those communities and the people recognizing that the companies are endeavoring to conduct a difficult public service on sound, fair and honest lines.

"Speaking generally, the business of the organization throughout the country is at the present time on as permanent a basis as that of any large business enterprise serving the public. It is protected by the grant from the proper authorities of rights in cities and towns and rights of way for toll lines that, in almost every instance, afford the necessary assurance of business permanency; and the necessity of the service is so thoroughly recognized that additional rights of this character are, as a rule, readily secured by a fair and reasonable understanding with those from whom such rights must be obtained.

"The plant is to a large extent stable

and standard. Fifty-four and one-tenth per cent, in miles, of all the exchange wire in the country is now in cables underground; and in the very many places where for technical or economical reasons it is impossible to go underground with exchange circuits, overhead cable construction has taken the place of the open wires formerly in use, to the great advantage of the telephone companies and their subscribers, inasmuch as liability to injury by storms is reduced and the service greatly improved.

"At the end of the year 1905 all except about twenty per cent of the exchange wire in the Bell system was in cables, overhead or underground.

"At the present time the companies making up the Bell system have in use not less than three hundred and twenty million pounds of copper wire, much of it in cables of a permanent type, the value of which, as copper, if removed and sold, it is easy to estimate; not less than 8,000,000 poles and 95,000,000 duct feet of underground conduit are installed and in use to support or contain this wire; but the actual value of this aerial and underground plant is no more to be measured by the value of the raw materials than is the value of a first-class railway in actual service to be based upon what could be realized from the rails and sleepers if they were to be removed and sold as junk.

"The real estate owned by the companies making up the Bell system, at the end of the year 1899, amounted to $12,997,458; at the end of the year 1905 it was $29,763,741.

"The requirements of the telephone business are such that in the larger cities it is a distinct economy and great advantage to the service that the companies should own their own buildings. Even in the smaller places it is often impossible to find proper quarters that may be leased, and an intelligent and conservative investment in real estate is as essential an element of a proper and well-organized telephone system as poles and wires and central office equipment.

"Since January, 1900, the number of telephones in the hands of the companies increased from 1,580,101 to 5,698,258; the total number of stations using Bell telephones, from 675,761 to 2,528,715; the miles of wire in toll and exchange use, from 1,518,609 to 6,043,518; the number of officers and employés of all classes, from 29,599 to 87,212; the number of yearly conversations, from 1,708,800,000 to 4,479,500,000. The American Bell system of the United States now exceeds, in the number of subscribers, mileage of wire and extent of traffic, the telephone systems of Great Britain and all of continental Europe combined.

"The American Telephone and Telegraph Company is the central company of a great organization which is giving telephone service throughout the country. Much of the operation, namely, all that which is local in its character, is done through its associated companies, each of which controls a definite territory within which it supplies telephone service. The American company itself owns and operates a comprehensive system of long-distance lines extending through and interconnecting the territories of the associated operating companies, which covers the United States from the Atlantic seaboard to and beyond Minneapolis, Omaha, Kansas City and the eastern portion of the Indian Territory. Its investment in these long-distance lines is about $35,000,000. Aside from the long-distance lines, its telephones which are leased to operating companies, and its real estate to the value of about $2,500,000, substantially all of its assets consist of securities of the associated companies.[1] These securities are carried on the company's books at a valuation that is distinctly conservative. To do its proportionate part, in the development of the business of those companies, the American Telephone and Telegraph Company sells and issues its own stock and bonds, investing the proceeds in stock, bonds and notes of the associated companies.

"The funds thus paid by this company into the treasuries of the associated companies, together with those derived from issues of stock to the other stockholders and from other purchasers of the securities of those companies, furnish the means to enable the associated companies to extend their properties, to construct and enlarge their exchanges, connect hundreds of thousands of new subscribers, and to build toll lines and erect buildings for the operation of central offices.

"Briefly stated, practically all of the money paid into the treasury of this company by subscribers to the issues of stock or bonds, with the exception of that expended from year to year for its own long lines and telephones, passes into the treasuries of the associated companies, in exchange for their securities, and is by them expended exclusively upon construction and additions to the plant.

"Through this process, the issues of securities by the associated companies, to the extent of the purchase of those securities, reappear in the capitalization of this company, that is to say, each $1,000 realized from the securities of the American Telephone and Telegraph Company which is paid over by it into the treasury of one of its associated companies appears again in the form of $1,000 of the securities of the company into whose treasury it is paid, and by which it is invested in plant.

"In like manner the dividends of the associated companies, that are paid to the company, reappear in the dividends paid by the company to its stockholders.

"Dealing with the capitalization of the companies in view of what has just been stated, that is to say, presenting the fact exactly as it exists, the aggregate capitalization of the American Telephone and Telegraph Company and its associated companies in the United States, including capital stock, and bonded and floating debt, was on January 1, 1906, as shown in the following table, which also shows certain other details of capitalization:

Entire capitalization (stock, bonds and all obligations as above) of all the companies, including this company	$334,524,583
Number of stations (excluding sublicensee and private line stations)	2,241,367
Average capitalization per station	$149
Deducting cost toll lines	$99,293,987
Balance, cost of exchanges[1]	$235,230,596
Average capitalization per station (excluding toll line investment)[1]	$105
Miles of toll wire	1,265,236
Average investment per mile of toll wire	$78

"It is only upon the aggregate capitalization above stated that the companies, including the American Telephone and Telegraph Company, have to earn and pay dividends and interest.

"It is to be borne in mind that these figures of capitalization and investment per station and per mile of toll wire are an average of all the stations and toll wire throughout the country. In many instances it is greater and in others less than the figures given, the cost in any particular case depending upon the character of the stations and toll lines, the condition of the plant with which they are associated and the cost of construction, which varies greatly under different conditions, such as the size of the city or town in which the exchange exists and the character of the country through which a toll line runs.

"There has been from year to year a

[1] In addition to its interests in the associated telephone companies, the American company holds stock in the Western Electric Company, which is a large manufacturer of telephone and other electrical apparatus and supplies. Outside of the United States, it is a holder of stocks and bonds in the Bell Telephone Company of Canada.

[1] In these items are included all the capitalization and investment of the companies, excepting only the cost of toll lines.

constant reduction in the investment per station, which has continued even through the recent years in which the cost of raw material and of labor has been much greater than ever before. This is due in part to economies in other directions, but mainly to two causes: first, the introduction of sound engineering and construction methods, which tend directly to economy of installation; and, second, to the fact that there have been developed to a substantial extent new classes of service, such as party and farmers' lines, private branch and hotel service and extension sets, where the cost per unit is much less than that of a special circuit and central office apparatus for each individual station of a standard exchange.

"The average cost of operation per station throughout the system has also been substantially reduced from year to year, in part from the same causes that have brought about a reduction in the investment per station.

"It is largely because of this reduction in the cost of construction and of operation that the Bell companies have everywhere been enabled to make such a marked reduction in their average rates during the past few years. The value of the service has been greatly increased by the addition to the system of a constantly increasing number of subscribers, many of whom were of the new classes to which the service has been extended and which required a relatively low rate. For a substantially more valuable and efficient service small users are now actually paying less than ever before and the cost to large users per unit of service has been reduced to at least an equal degree.

"The active competition which has existed for many years in many portions of the country still continues, in some cases to the detriment of certain of the companies. It seems clear, however, that within the last three years the general situation, in so far as competition is concerned, has become distinctly more favorable to our interests.

"In many portions of the country in which the business was unprofitable a few years ago, it is now in satisfactory condition, and there are but few companies of those which have had to face strenuous competition in which there are not definite indications of an improved condition. In some instances the recovery may be slow, but we believe that it is sure to come everywhere in a reasonable time.

"That the competition of two telephone companies, operating in the same field, is an economic mistake, from the standpoint both of the investor and the telephone-using public, is coming to be more and more fully recognized.

"The subscriber, to derive the greatest value from telephone service, should be enabled to connect with all subscribers in his exchange area. If there are two com-

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

EARNINGS.

	1904.	1905.
Dividends	$8,400,301 18	$8,897,879 95
Rental of instruments	3,438,605 54	3,896,151 27
Telephone traffic	5,575,447 90	6,529,556 82
Real estate	76,782 49	82,384 46
Interest	1,055,522 10	2,306,858 79
	$18,546,659 21	$21,712,831 29

EXPENSES.

Expenses of administration (including legal 1904, $83,530 42) (" " 1905, 93,126 68)	$1,187,023 37	$1,313,586 32
Interest and taxes	2,670,083 61	3,578,681 86
Telephone traffic	3,413,850 48	3,786,524 72
	$7,270,957 46	$8,678,792 90
Net revenue	$11,275,701 75	$13,034,038 39
Dividends paid	9,799,117 50	9,866,355 00
Balance	$1,476,584 25	$3,167,683 39
Carried to reserves	$586,149 20	$1,743,295 16
Carried to surplus	890,435 05	1,424,388 23
	$1,476,584 25	$3,167,683 39

WM. R. DRIVER, *Treasurer.*

LIST OF STOCKS AND BONDS OWNED BY AMERICAN TELEPHONE AND TELEGRAPH COMPANY DECEMBER 31, 1905.

	Shares.	Per Cent of Whole Stock.
Bell Tel. Co. of Buffalo	30,390	50.23
" " " " Canada, Ltd	34,721	38.58
" " " " Missouri	34,508	66.27
" " " " Philadelphia	*258,351	80.81
Cent. Dist. & Ptg. T. Co	66,940	66.94
Cent. New York T. & T. Co	6,603	68.67
Cent. Union Telephone Co	41,839	76.76
Ches. & Potomac T. Co	15,121	57.06
Chicago Telephone Co	72,850	52.04
Cincinnati & Sub'n Bell T. Co	*27,163	30.00
Cleveland Telephone Co	7,000	22.58
Colorado Telephone Co	*57,501	52.81
Cumberland T. & T. Co	70,056	52.09
Empire State T. & T. Co	1,378	68.94
Hudson River Telephone Co	20,331	52.00
Iowa Telephone Co., Pref	†36,996	99.19
" " " Common	†12,780	25.29
Missouri and Kansas T. Co	19,442	53.72
Nebraska Telephone Co	15,372	58.33
New England T. & T. Co	161,839	58.27
New York Telephone Co	322,157	64.43
New York & N. J. Tel. Co	15,115	8.78
New York & Pa. T. & T. Co	5,007	50.07
Northwestern Tel. Exchange Co	*21,496	17.91
Pacific States T. & T. Co	85,172	50.10
Pennsylvania Tel. Co	*40,173	61.88
Pioneer T. & T. Co	5,060	57.62
Providence Telephone Co	*12,000	30.00
Rocky Mountain Bell T. Co	11,759	51.04
So. Bell T. & T. Co	147,945	99.96
So. New England Tel. Co	16,590	33.18
Southwestern T. & T. Co	16,402	16.40
Western Electric Co.‡	72,099	60.08
Western T. & T. Co., Pref.§	121,876	76.17
" " " Common	91,435	57.15
Wisconsin Telephone Co	5,051	16.77
Miscellaneous	5,662	

BONDS.

Bell Telephone Co. of Canada, Ltd	$301,000
Cent. Union Tel. Co	1,000,000
Duluth Telephone Co	210,000
Iowa Telephone Co	750,000
New England T. & T. Co	581,000
Miscellaneous	138,000

The par value of the above-named stocks is $100, except when otherwise stated.

* Par, $50.
† Par, $25.
‡ The Western Electric Company is a large manufacturing corporation having factories in New York and Chicago.
§ The Western Telephone and Telegraph Company owns:

Cleveland Telephone Co	24,000	77.42
Northwestern Telephone Exchange Co	98,504	82.09
Southwestern T. & T. Co	83,598	83.60
Wisconsin Telephone Co	24,746	82.19

panies, the subscriber having considerable business interests finds it almost indispensable that he should be connected with both companies, at increased cost and inconvenience. Those who have the service of one company only can not carry on conversation by telephone with the subscribers of the other company and have therefore no connection with a portion of the telephone-using public.

"The competing companies, having an erroneous idea of the cost of giving service, for the most part undertook to secure subscribers by offering telephone service at a price that was unremunerative. This has been shown in many ways, among others by their repeated efforts to raise the low rates originally established. Many of them were and are capitalized at a high rate, from $200 or $250 and even above $350 per station, as compared with a much lower average per station of the Bell companies operating under similar conditions; and their gross revenue, as far as the same is made public, is, as a rule, far below the amount requisite to cover expenses of operation and even a moderate return upon the capitalization. It is hard to find a competing company that in its published figures does not purport to operate at an aggregate expense of not more than sixty per cent of its gross receipts; and in some cases from the figures and prospectuses of such companies it would appear that from thirty-five to fifty per cent of the gross receipts are regarded as sufficient to pay all the expenses of carrying on the business, including maintenance and depreciation, to the extent to which, as is not infrequently the case, these essential items of expense are not ignored.

"In spite of the great progress that has been made in the past few years the work is not yet completed. We have still much to learn and many improvements to make before the business can be brought to the perfection for which we aim. The zeal and energy with which, throughout the country, the executive officers, the engineers, the traffic men and others upon whom the future development of the service depends, are working for the results we hope to attain, afford every assurance that there will be continuous progress from year to year in the right direction, and we believe that the efforts to give the country such a telephone service as it requires are appreciated and will be more appreciated as time goes on.

"At a special meeting of the stockholders held December 21, 1905, authority was given to issue convertible bonds of the company to the amount in the aggregate of $150,000,000.

"By the terms of a contract dated February 8, 1906, convertible bonds to the amount of $100,000,000 were sold to Messrs. J. P. Morgan & Company; Kuhn, Loeb & Company; Kidder, Peabody & Company and Baring Brothers & Company, Limited. The terms of the sale were favorable to the company, and the directors believe that the transaction was of distinct advantage to the company and to each individual shareholder.

"It is expected that the funds provided by this sale will supply the money required for the development of the business until well into the year 1908, including the payment of $20,000,000 of notes of the company due May 1, 1907."

Copper, the Electric Metal.

The following extract is taken from an article entitled "Copper, the Electric Metal," by Charles H. Cochrane, in the March issue of *Moody's Magazine*:

The period from 1888 to 1902 marked our greatest growth in electric railways. During those years, with the continuous demand for heavy wires for the trolleys and for feeders, the United States copper production increased from 100,000 to 300,000 tons a year. Hardly did the street railways secure a sufficient supply of copper than the lighting interests demanded more and more, and the call for copper for dynamos and motors and wire to connect them increased with every year. Latterly the long-distance telephone business has been making heavy demands for copper wire; and now, in this year of grace, 1906, when we already want more copper than we produce, word comes that the great trunk line railways are about to electrify, and it paralyzes the statistician to calculate how much copper they will require in the next ten years, in the process of overturning methods of long-distance railway haulage.

Foreign countries also call for more copper than they can mine. They have purchased of us regularly for years, taking nearly half of our copper, until last year the home demand cut down the exports materially, with the single exception of China, which kept on buying regardless of the increased cost. If China is to have electric railways and electric light and power, and is relying on us for copper, here is another demand that will be hard to supply. The condition will perhaps stimulate the copper mines of Japan, which are promising, although the insular demand for the metal also increases rapidly. Since Africa has launched a series of railways projects that bid fair to equal our own long lines in a generation hence, and since these lines, in the very nature of modern progress, must be largely electrical, it follows that the demand for the gleaming metal will be world-wide. Then, where is all the copper to come from?

Mining engineers are confident that old Mother Earth has plenty of the electric metal stored away for our future use, and at this writing I could name several prominent large mining interests that have agents looking for copper properties, with a view to development.

Ninth Annual Convention of the Michigan Independent Telephone Association.

The ninth annual convention of the Michigan Independent Telephone Association was held at Ann Arbor, Mich., March 22 and 23. The following program was announced:

THURSDAY AFTERNOON, 1.30 O'CLOCK.

"President's Address," E. B. Fisher, secretary Citizens' Telephone Company.

"Northwestern, Ohio," R. E. Hamblin, general manager Toledo Home Telephone Company.

"Concerning Competition," C. B. King, manager Home Telephone Company, Ann Arbor.

"Progress and Prospects," W. O. Hunt, Adrian, Mich.

"Progress Traffic Association," W. S. Vivian, Grand Rapids, manager State Traffic Association.

"Our Investments," E. S. Wagar, banker, Edmore.

"The Detroit Situation," W. B. Woodbury, general manager Home Telephone Company, Detroit.

EVENING SESSION, 7.45 O'CLOCK.

"A Bit of History," H. H. Hutchins, president Saugatuck Telephone Company.

"The Cedar Supply," H. P. Grover, Grand Rapids.

"Crowding Collections," F. V. Newman, manager Grand Rapids Exchange.

"Southern Michigan," R. C. Smith, manager Homer Telephone Company.

"The Indiana Outlook," W. L. Moellering, general manager National Telephone Company, Ft. Wayne.

"Ohio's Successes," Frank L. Beam, president Ohio Telephone Association, Columbus.

FRIDAY MORNING, 9 O'CLOCK.

Traffic association report, C. E. Tarte, president Michigan State Traffic Association.

District reports, vice-presidents of state association.

Treasurer's report, Wm. Robinson, Muskegon, association treasurer.

Secretary's report, J. B. Ware, Grand Rapids, association secretary.

Election of officers.

Unfinished business.

SOME FEATURES AFFECTING THE PARALLEL OPERATION OF SYNCHRONOUS MOTOR-GENERATOR SETS.[1]

BY J. B. TAYLOR.

In this paper the phrase "synchronous motor-generator" means an alternating-current synchronous motor directly connected to an alternating-current generator.

The most common use of motor-generator sets is to effect a change in frequency, so that standard lighting apparatus, alternating-current arc lamps, etc., may be operated from a system of lower frequency designed primarily for railway or power purposes. Such sets are also used as a means of interchanging power between systems already established and operating at different frequencies.

The operation of the single-phase railway motor calls, in some cases, for a motor-generator set with inverted frequencies; that is, a sixty-cycle synchronous motor in connection with a twenty-five-cycle generator. With such a combination there may be obtained an energy transfer from a three-phase system to a single-phase system without unbalancing the three-phase system.

Considerable difficulty was experienced with some of the first of these sets; for instance, a set on being started and connected in parallel with others already carrying a load would, on some occasions, refuse to take any of the load and at other times it would take a great deal more than its proper share of the load. These troubles were due, mainly, to lack of consideration of the possible combinations of phase relations of any given set depending on connections and load. It is also evident that suitable switching devices and method of procedure for a ten-pole—twenty-four-pole combination, operating between twenty-five and sixty-cycle systems, will not be suitable for a four-pole—ten-pole combination operating between twenty-five-cycle and 62.5-cycle systems. As a result of these early troubles, a number of station operators retain the impression that unless certain special combinations of field excitation are used at the instant of parallelling, the proper division of load will not result; and that once being connected in parallel, further changes in field excitation will have no effect.

In order to understand the operation of a synchronous motor, it is necessary to have some definite reference point. This reference point must rotate in synchronism with the electromotive force of the system connected to the terminals of the synchronous motor, and must also maintain the same phase relation to the electromotive-force wave. In Fig. 1, let A represent the reference point rotating about the point O, and let N S, etc., represent the four revolving poles of a synchronous motor. Since the reference point A and

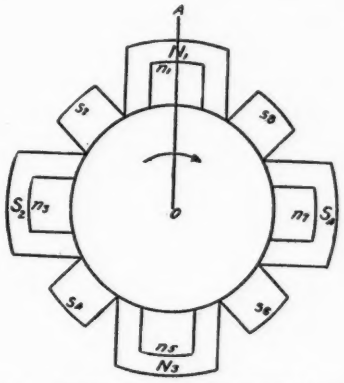


FIG. 1.—FOUR-POLE SYNCHRONOUS MOTOR, EIGHT-POLE GENERATOR, NO LOAD.

the poles N S, etc., rotate at the same speed, and since only the relative positions need be considered, the diagram at rest can be examined with the same result as if the diagram rotated at synchronous speed with the observer stationed at the point A. If Fig. 1 represents the relative positions of reference point and field for the condition of no load on the motor, it is apparent that with a load the relative positions will be as represented in Fig. 2, in which case the rotating field will lag behind the no-load position by an angle A O N, the number of degrees in this angle being dependent on the load, the

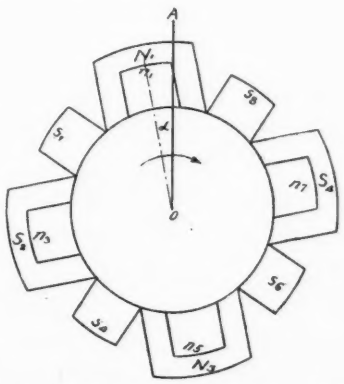


FIG. 2.—FOUR-POLE SYNCHRONOUS MOTOR, EIGHT-POLE GENERATOR. AoN LAG-ANGLE DUE TO LOAD. DIRECTION OF ROTATION SHOWN BY ARROW.

number of poles, the field excitation, and on the magnetic and electrical design of the machine. If this motor be coupled to a generator having twice the number of poles, as indicated by N S, etc., it is apparent that the lag-angle A O N will cause the generator electromotive force to lag a corresponding number of electrical degrees, which will be twice as many as the number of electrical degrees displacement on the motor; for example, with a four-pole motor and eight-pole generator and angle A O N ten degrees (mechanical), there would be a corresponding electrical displacement of twenty degrees for the motor and forty degrees for the generator.

In addition to the phase displacement of the generator electromotive force due to the angular lag of the motor, there is a further displacement between the electromotive force of the generator of the set under load and the set under no load, due to the phase difference between the generator induced electromotive force and the generator terminal electromotive force; the amount of this displacement depending on the amount and power-factor of the load, and also on the design of the generator.

Two sets of identical construction, connected in parallel on both motor and generator ends, will each take the same amount of load, provided field excitations are equal. If either set has a motor or a generator designed for closer regulation than the corresponding machine of the other set, the set having the closer regulating machines will take more than its share of the load.

In the previous discussion it has been assumed that the mechanical construction of the two sets is identical. Since identical mechanical construction involves perfect alignment when machining the keyways, milling slots for pole pieces, armature laminations, etc., it is difficult to construct two sets having an initial phase difference of less than two or three degrees; and this difficulty increases with machines of different design and rating constructed at different times. This point is of first importance in machines of this class, as a manufacturing company may any day receive an order for a machine, say, of 1,000-kilowatt capacity to operate in parallel with machines of 200 or 500-kilowatt capacity already in service and constructed four or five years ago. If slight differences in machining cause the generator of one set to have an electromotive-force wave in advance of the wave of the other sets, this machine will, at no load on the system, reverse the action of the other sets, causing the generators to act as motors, and the synchronous motors to act as generators. Such contingencies are provided for by constructing the sets so that one of the machines may be shifted slightly axially.

Consider a set working between twenty-

[1] Abstract of paper read at the recent meeting of the American Institute of Electrical Engineers.

five and sixty cycles. The smallest number of poles possible in this combination is ten for the motor and twenty-four for the generator. Fig. 3 represents such a set. A study of this figure will show that there are but two poles on the motor which must stand even with the reference point A in order to give proper phase relations on the generator end. Therefore, with one of these sets in service, to connect in parallel a second set it is necessary to bring one or the other of these two poles to the reference point, the reference point being already determined by the set in service. This means that it is not sufficient to phase the set for one end only, but it must be phased for both motor and generator ends simultaneously. This may be done by one of several methods, as will be explained under methods of starting.

Synchronous motor-generator sets may be started by applying alternating currents, preferably at low voltage, to either end of the set. With this method there is no need of synchronizing as the term is ordinarily applied. It is, however, essential in some cases to make further manipulation to secure proper phase relations.

Many of these sets are provided with direct-connected exciters, and in some cases these exciters are used as starting motors. Another combination is the use of an induction motor connected to the set, and provided for the specific purpose of starting. Either of these last two methods requires synchronizing, and, as explained above, in some cases special or additional manipulations to obtain proper simultaneous phase relations.

In order to secure proper phase relations at both ends of the set, the Chicago Edison Company makes use of a special synchronism indicator with two hands appearing on the same dial. The twenty-five-cycle synchronous motor is started by means of alternating current applied to its windings, and after synchronous speed is reached the sixty-cycle end has one chance in five of being correct for connecting in parallel with other sets already in service. The position of the sixty-cycle hand on the synchronism indicator shows whether or not the phase relation is correct. If incorrect, the switch supplying the synchronous motor is opened and the set begins to slow down; the two hands of the synchronism indicator begin to revolve at different speeds, the sixty-cycle hand making 2.4 revolutions for each revolution of the twenty-five-cycle hand. There is one instant when both hands will appear at the top of the dial at the same time, indicating proper phase relations for both machines; at this instant the operator closes the switch on one machine, and as soon as the switch on the other machine is also closed the set is in parallel with those already in service, and takes its proper share of the load.

Similar sets at the Amsterdam substation of the Fonda, Johnstown & Gloversville Railway Company are started by means of alternating current at approximately one-half the line potential, 13,200 volts. In this station transformers supplying synchronous converters are incidentally used as compensators, to obtain the half-voltage for starting the synchronous motors of the lighting sets. When the set has reached synchronous speed, however, a different method from that em-

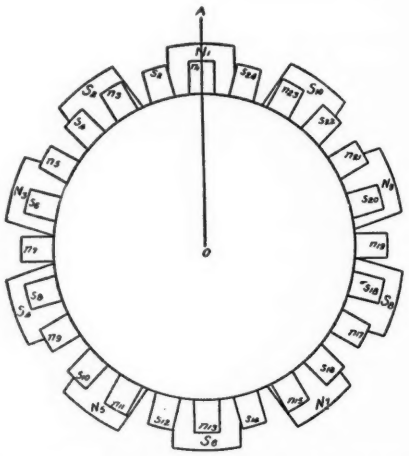


FIG. 3. — SYNCHRONOUS MOTOR, TEN POLES, TWENTY-FIVE CYCLES; GENERATOR, TWENTY-FOUR POLES, SIXTY CYCLES, 300 REVOLUTIONS PER MINUTE.

ployed at Chicago is used to obtain proper phase relations on the sixty-cycle generator.

Referring again to Fig. 3, it will be seen that there is one chance in five of the generator potential being in phase with the bus-bars. Phasing lamps and voltmeter connected between the incoming generator and the bus-bar show whether or not the phase relation is correct for connecting in parallel. If this phase relation is correct the voltmeter reading is normal and the lamps burn at normal brilliancy. Any one of the other four possible phase relations will, however, give a different reading on the voltmeter and only partial illumination of the phase lamps. A double-pole, double-throw reversing switch in the circuit of the synchronous-motor field is employed to step the motor back one pole successively at a time until the generator stands in the same phase relation to the bus-bar or to the machine, or machines, already in service. As stated previously, each pole of the motor corresponds to 2.4 poles on the generator, which is equivalent to one complete cycle and seventy-two degrees additional. As stated above, there is one chance in five that the generator potential will be in proper phase, in which case this stepping back, or "slipping" of the motor will be unnecessary. As it is purely a matter of chance which one of the five phase positions exists at the generator, it will usually be necessary to reverse the motor field successively two or three times; in the worst case it will be necessary to reverse the motor field four times in succession. After the correct phase position has been obtained the generator may be connected to the bus-bars, and the set will take its share of the load.

The same method is followed by The Milwaukee Electric Railway & Light Company. Synchronous motors are started by means of compensators. A sixty-cycle synchronism indicator shows which of the five phase positions obtains at the generator. One of these positions is correct for paralleling, and the remaining four points are marked 1, 2, 3, 4, indicating the number of times that the motor field-switch must be reversed.

The sequence of operation in placing a set in service in this manner, is then as follows:

1. Close the oil switch connecting the synchronous motor to half voltage taps on compensator transformers.

2. When the motor has reached synchronous speed, excite the fields of both motor and generator.

3. Reverse the field of the synchronous motor—unless the generator happens to be in proper phase—until the indicating devices show that the correct position has been obtained.

4. Transfer the synchronous motor from the half-voltage taps to the twenty-five-cycle bus-bars; this is done by means of a double-throw switch, or its equivalent of two separate switches mechanically or electrically interlocked.

5. Connect the sixty-cycle generators to the bus-bars.

The mode of operating this combination has been described in detail, as the method is general and may be applied to sets having any combination of poles, speeds, and frequencies, although for those sets in which the ratio between motor poles and generator poles is a whole number, the generator phase relations must of necessity be correct. Also, for certain other combinations in which there is one chance in two of the generator polarity being correct, a field-reversing switch on the generator serves quite as well as one on the

motor, and slightly simplifies the operation. Furthermore, in certain special combinations of poles, field-reversing switches on both motor and generator may be employed, this combination reducing the number of times that the motor field must be successively reversed to bring the generator to its proper phase position.

Obviously, in those cases where the sets are started by such means as direct-connected exciters or induction motors, we may use either a double synchronism-indicator, connecting either motor or generator to the bus-bars at the instant when the indicators show proper phase relations for both machines, or we may merely synchronize the motor by the ordinary methods, and then obtain proper phase position for the generator by suitable field-reversing switches.

Fig. 4 shows the interchange of load between two similar 500-kilowatt sets

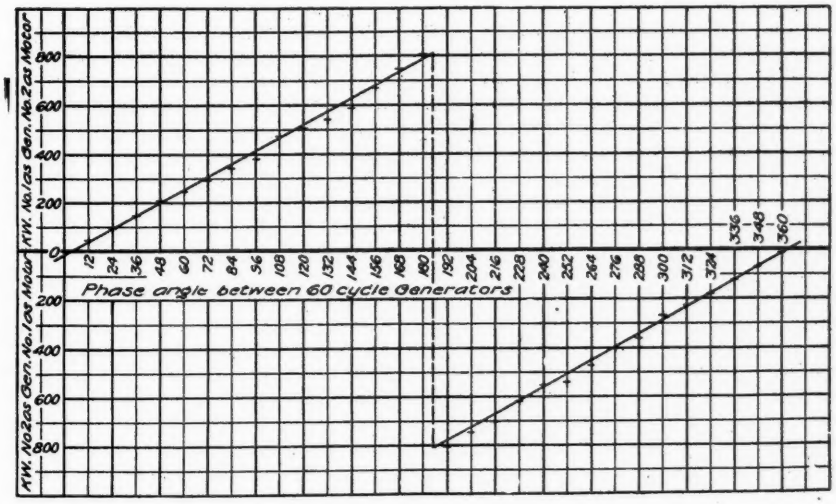


FIG. 4.—INTERCHANGE OF POWER, TWO 500-KILOWATT, TWENTY-FIVE TO SIXTY CYCLES, SYNCHRONOUS MOTOR-GENERATOR SETS. SIXTY-CYCLE GENERATOR, HELD AT 2,300 VOLTS; TWENTY-FIVE-CYCLE MOTOR, HELD AT 100 PER CENT POWER-FACTOR.

working between twenty-five and sixty cycles. This curve gives the wattmeter readings, showing interchange of load between the two sixty-cycle machines when connected in parallel with a given phase displacement. The thirty different phase positions were obtained by changing connections, as outlined previously. The wattmeter readings were obtained from polyphase instruments, and during the test the excitation of the synchronous motor was held so as to keep the power-factor indicator at 100 per cent; the generator voltage was held at normal, 2,300 volts, by changing field excitation as required by the load. It will be seen that the curve does not cross the base line at zero degrees, these being machines which have been referred to in another part of the paper as having an initial phase displacement, due to slight errors in machining, of approximately four degrees.

Where a number of synchronous motor-generator sets are operated from the same exciter bus-bars, a reversal of exciter polarity will affect all the sets in the same manner, and hence will give no trouble. It should be noted, however, that when the machines are provided with individual direct-connected exciters, or when two or more sub-stations are operated in parallel, a reversal of one exciter may seriously interfere with the ability to connect this machine, or the entire sub-station in parallel with others. This point, like many others in connection with these sets, does not hold for all the different combinations of frequencies; but, unless borne in mind and understood, may be a source of sudden inability to make use of a machine for carrying the load.

It has been previously noted that the generator of a set, before connection to the bus-bars, has a terminal electromotive force in advance of the bus-bars, or machines already under load. This means that with the usual method of procedure, at the instant of connecting the machine to the bus-bars, it has a tendency to take momentarily more than its share of the load. In practice, however, this is not found to be a serious objection, although it might be obviated in various ways; for example, a reactive coil in the motor leads would allow sufficient phase difference between the motor bus-bars and the motor itself to give the same phase relation at the generator terminals as at the generator bus-bars. After connecting the generator to the bus-bars the reactance can be gradually cut out; or, if left in, could be used to permit a change in division of load by adjusting the motor-field excitation. If the generator is connected to its bus-bars before the motor is connected to its bus-bars, the set will settle down to its proper division of load by the reverse process; that is, instead of first taking more than its share of the load and then settling down, the generator will, for a short interval of time, act as a motor and gradually assume its proper load as a generator. It should also be noted that there will be a given excitation for an incoming generator, which will give a minimum disturbance on the system, and this excitation having been found experimentally, there should be no appreciable flicker in the lights while connecting the new machine.

An interesting condition that might arise with sets in which the ratio of frequency is quite large, would be a phase displacement of 180 degrees or more between the set under load and the set under no load. This might occur with a set operating between twenty-five and 125 cycles; as an angular lag of thirty degrees on the motor end would mean 150 degrees on the generator end, and an additional angle of thirty degrees in the generator itself would give 180 degrees. Under these conditions it would be impossible properly to parallel the set under no-load with the set carrying a load, except by some manipulation which would reduce the angle to less than 180 degrees. One way of accomplishing this would be to connect an artificial load on the set to be placed in service.

Some change in the division of load between sets may be effected by changes in excitation of generator, or motor, or both. Such means of securing division, however, is not to be recommended; it is done at the expense of leading or lagging currents, with consequent increased heating losses.

The present general tendency toward extension and consolidation means that more and more systems will touch and overlap their neighbors, which may have started at different frequencies. We can, therefore, look for an increasing use of the synchronous motor-generator set.

New York Electrical Society.

Announcement is made that Mr. William Marconi, who was to lecture before the New York Electrical Society at Columbia University, Wednesday evening, April 4, has been taken suddenly ill, and will be unable to appear. The society has been invited to attend the lecture by H. D. Hawks, on "Electric Locomotives," before the Electrical Engineering Society of Columbia University, engineering building, the same evening.

THE COOPERATIVE ELECTRICAL DEVELOPMENT ASSOCIATION.

CONFERENCE IN NEW YORK TO DISCUSS PLANS FOR PROFITABLE COOPERATION IN DEVELOPING THE USE OF ELECTRICAL CURRENT AND APPARATUS.

A new organization planned along original lines by Mr. J. Robert Crouse, of Cleveland, Ohio, is known as the Cooperative Electrical Development Association. Mention of this association has been made in the ELECTRICAL REVIEW before and its purposes outlined. On Friday of last week, at the invitation of Mr. Crouse, a number of electrical manufacturers and central station and technical press representatives participated in a discussion over the merits and possibilities of this association. The meeting was held in the afternoon at the Hotel Imperial, New York city, and in the evening a banquet was enjoyed and after-dinner speeches on this subject were made.

The business session in the afternoon was ably presided over by Mr. E. E. Jackson, Jr., and in the evening Mr. W. M. McFarland, of the Westinghouse Electric and Manufacturing Company, was the very agreeable toastmaster. Among those in attendance in the afternoon and evening were the following: E. E. Keefer, Western Electric Company, New York; W. H. Blood, president, National Electric Light Association, Boston, Mass.; Paul Spencer, United Gas Improvement Company, Philadelphia, Pa.; J. E. Montague, general manager, Niagara Falls Electric Light and Power Company, Niagara Falls, N. Y.; F. Bissell, the F. Bissell Company, Toledo, Ohio; Charles B. Price, Pettingell-Andrews Company, Boston, Mass.; Charles A. Parker, Curtis Advertising Company, Detroit, Mich.; Converse D. Marsh, Bates Advertising Company, New York city; Ivy L. Lee, New York city; E. E. Calkins, New York city; John Craig Hammond, the John Craig Hammond Advertising Company, Denver, Colo.; W. C. Bryant, president, Bryant Electric Company, Bridgeport, Ct.; M. K. Eyre, Sawyer-Man Electric Company, New York city; Anson W. Burchard, assistant to the president, General Electric Company, New York city; A. D. Page, General Electric Company, Harrison, N. J.; G. F. Morrison, General Electric Company, Harrison, N. J.; F. S. Terry, first vice-president, National Electric Lamp Company, Cleveland, Ohio; B. G. Tremaine, second vice-president, National Electric Lamp Company, Cleveland, Ohio; H. L. Shippy, John A. Roebling's Sons Company, Trenton, N. J.; Leroy Clark, Safety Insulated Wire and Cable Company, New York; F. Bristow, treasurer, Weston Electrical Instrument Company, Newark, N. J.; S. O. Richardson, Jr., Libby Glass Company, Toledo, Ohio; A. H. Patterson, Phoenix Glass Company, New York city; J. C. Fish, Shelby Electric Company, Shelby, Ohio; N. L. Norris, Banner Electric Company, Youngstown, Ohio; J. Robert Crouse, Cleveland, Ohio; J. S. Anthony, General Electric Company, Schenectady, N. Y., and F. H. Gale, General Electric Company, Schenectady, N. Y.

Mr. J. Robert Crouse delivered a very interesting address entitled "Profitable Cooperation," and a number of the main points in it are presented herewith:

Permit me at the outset to assure you that I am not lacking in appreciation of the responsibilities involved in bringing together a body of representative men like yourselves from all branches of the electrical industry.

I have, however, assumed it for two reasons:

1. The knowledge that the proposition is made up of the best thought of yourselves and others, which it has been my personal fortune and pleasure, through accident largely, to put into such orderly arrangement as may appear.

2. The firm personal conviction, therefore, that what I have to say is of considerable commercial importance to you.

You will grant me some further basis for calling the meeting from the fact that forty-five electrical manufacturers, who have seen the plans develop during a period of a year and a half past, have given effective expression to their confidence in them by the appropriation of $60,000 for their partial execution during the coming three years.

The proposition, then, which it is my object to demonstrate to you is the further appropriation by electrical manufacturers generally of one-tenth of one per cent of their sales for a like period of three years to make possible the more effective prosecution of the work already under way.

As a text for the discussion of profitable cooperation as herewith specifically advanced, I quote the objects of the association as they appear in the proposed plan of organization which you have in hand.

1. The promotion of the increased and more extended use of electric current by the public for light, heat and power as a means to the increased demand for electrical apparatus and supplies, and the cooperative planning and execution of various means and methods effective to this end.

2. The establishment of cooperative relations, both moral and financial, among the different electrical interests from manufacturer to the consumer, to the end that each may contribute in some measure toward bringing about the above results desired in common by all.

To prove the soundness of cooperation as a permanent system it must accomplish some of the following results:

1. Produce proportionately greater selling results if involving additional selling expense.

2. Produce equal selling results with commensurate decrease in present selling expense.

3. Call into play voluntary constructive selling forces which can be influenced by cooperation more largely than by money.

This latter, while possibly the slowest feature to develop, will, I believe, be found in the end to be the meat of profitable cooperation, and the organization and moneys involved, the shell.

4. Even without precedent, as appears to be the case in point, it should successfully stand comparison with the apparent commercial tendencies of the time.

Right at the start let us get squared away on the general proposition that the electrical industry as a whole is seriously under-advertised and exploited if measured in the terms of other comparable industries, or of its older competitors in the field of light, heat and power, particularly in the gas field.

If this be conceded at least for the purposes of the discussion, it would be most ungenerous and unprofitable to undertake to fix responsibility on any particular branch of the industry. I do not doubt that, on the show-down, each could make a good case out against all the others. In the spirit of cooperation, therefore, let it be assumed, as is doubtless the case, that we are all in greater or less degree responsible for any conditions, prosperous or otherwise, which exist and mutually interested in any proposition promising improvement.

With the object of working out the plans in entire harmony with the central station interests, the subject was placed before the Denver convention of the National Electric Light Association in June, 1905, and request made for the appointment of a cooperating committee to assist in the work. (For complete details see the proceedings of that convention, vol. i, following page 366.) Repeated meetings have been held with this committee as well as with President Blood, *ex officio*. In addition, representative central station managers have been freely consulted and particular acknowledgment is due to Mr. Henry L. Doherty, who has given to the subject for months past freely of his time and attention.

These gentlemen will bear me out, I believe, in the statement that the plans are drawn along lines which will not only secure the hearty cooperation and active support of central station managers, but will be a practical means of very greatly assisting in the extension of electric service, and the demand for electrical apparatus and supplies.

Recognizing the influence of the electrical papers upon which the industry depends for general information regarding the progress of the art, their cooperation and assistance were sought along lines which it was believed would work out mutually advantageous. They fully agreed that there was an important work to be undertaken along the lines discussed, and

in a spirit of cooperation opened up special departments in their columns devoted specifically under suitable captions to the topics of "More Business" and "New Business."

These columns, therefore, constitute a ready clearing house for the presentation, discussion and criticism of new business methods. In the course of time it may reasonably be expected that central station managers will be glad to freely interchange their views on commercial topics. As this is increasingly accomplished, particularly effective commercial policies developed in one place and used locally can be brought to the direct attention of all the central stations, thereby multiplying its effectiveness by a fair percentage of all the central stations.

If the plans as discussed with the electrical papers are carried out, they certainly will have contributed very largely toward increasing the consumption of electric current, and in consequence the demand for apparatus and supplies. As evidence of what they have already done along these lines, I call your attention to the fact that, inclusive of all the electrical trade papers, there have been published during the first three months of 1906, one hundred and forty-nine columns of purely commercial and new business-getting subjects as against thirteen and one-half columns for the same period of last year, an increase of one thousand and three per cent.

The report of the Department of Commerce and Labor for 1905, covering 1901 figures, give the income of central stations as $86,000,000, divided among the different services as follows:

Incandescent lighting	52.1
Arc lighting	29.7
Motors	16.4
Miscellaneous	1.8

The figures for 1905 are placed by competent authorities at $135,000,000. Comparatively few of the central stations are now spending in aggressive business getting from two to three per cent of their gross income, usually devoting two-thirds to personal solicitation and one-third to supplementary advertising service. If, as the result of assistance and cooperative work, this could be made the prevailing practice instead of the exception, a minimum of $2,700,000 or a maximum of $4,050,000 might be wisely and profitably spent by central stations in the extension of the use of electric current.

The appropriation of $287,000 by the manufacturers for this cooperative work which was suggested in the Denver paper before referred to, would all be returned to the manufacturers in one year if it resulted in an increased demand for electrical apparatus and supplies of $1,913,330, estimating the profit on this amount of added business at fifteen per cent. This increase would amount to only 1.34 per cent above the normal rate of growth and which it is believed it is not unreasonable to expect might be accomplished.

As further suggestive of the possibilities of returns materially in excess of the figures indicated above, consider the following concrete example:

Quantity of incandescent lamps sold in 1905	45,000,000
One per cent gain in growth over normal rate	450,000
Electrical horse-power equivalent of 450,000 lamps (13 to the horse-power)	34,615
Cost per horse-power of all equipment necessary to operate	$125
Resulting in an increased demand for apparatus and supplies of	$4,326,875

The above illustration is taken by reason of the writer's familiarity with the incandescent lamp business, but as the entire plan would be equally and impartially directed to stimulating the use of all kinds of current-consuming devices requiring the use of motors, electrical heating devices, arc lamps, glower lamps, tube lamps, etc., the possibilities of the successful conduct of this proposed association will be appreciated.

In conclusion, the general principle of commercial cooperation and generic selling as here advanced we believe is essentially correct and will be a matter of common practice and no particular comment in the not distant future.

The manufacturers with whom all the means of electrical service originate are by reason of financial strength and the conditions under which manufacturing is at present organized, the logical interests to initiate the movement. They have it in their power to set the example of broad-gauged and effective cooperative work, which will at the same time meet with the most cordial endorsement and cooperation at the hands of the entire distributing and purchasing trade, and a logical conclusion of which is that every well-defined interest in the industry will eventually participate financially in the work in reasonable proportion to the benefits derived.

I am not willing up to the present writing to believe that this great electrical industry of which we are all so proud, typical of modern progress and charged with unmatched possibilities for the future in its mechanical and electrical development, will be unwilling or unequal to the task of launching and carrying to a successful conclusion a commercial project of this kind.

This specifically means to the manufacturers a tax of $1 per $1,000 of sales; $10 per $10,000 of sales; $100 per $100,000 of sales; $1,000 per $1,000,000 of sales; in other words, one-tenth of one per cent.

To this very representative electrical court of last resort, reflecting so large a percentage of the commercial ingenuity and financial strength of the industry, with due respect to those absent, I submit the question: Is not the Cooperative Electrical Development Association and what it stands for worth our serious while?

This address was followed by discussion, all speakers favoring in general terms the ideas presented by Mr. Crouse.

It was moved by Mr. Anson W. Burchard and seconded by Mr. W. H. Blood, Jr., that it is the sense of this meeting that the cooperative commercial campaign for the purpose of increasing the use of electric current by the public for light, heat and power, as both an end and a means to the increased demand for electrical apparatus and supplies as presented and discussed, gives good promise of highly profitable returns to all concerned, and that the general plans for its prosecution through the Cooperative Electrical Development Association can be undertaken along equitable and practicable lines.

It was also moved by Mr. Burchard, and seconded by Mr. W. M. McFarland, that a committee of eleven or more representatives of electrical interests be appointed by the chair for the purpose of considering the plans submitted for the organization of the Cooperative Electrical Development Association, and to complete and agree on a practicable form of organization with a view of putting the same into operation. It was

Resolved further, That this committee be authorized to confer on the subject with cooperating committees already appointed, or other representatives which may be appointed from other well-defined lines of the trade, so that adequate provision may be made in the plans of organization for immediate moral cooperation, as well as possibly financial cooperation at a later date.

Resolved further, That the plans of organization, when completed by this committee, be submitted to the representatives of the interests present, so that the entire proposition may be passed upon by their respective bodies or companies; and when, in the opinion of this committee, a sufficient number of the interests have agreed to cooperate in the work, it shall be authorized to perfect the organization and to supervise its initiatory work.

The chairman of the meeting appointed the following committee as covered by the foregoing resolutions:

W. M. McFarland, acting vice-president of the Westinghouse Electric and Manufacturing Company, chairman.

J. R. Lovejoy, General Electric Company.

Walter Cary, Sawyer-Man Electric Company.

A. D. Page, General Electric Company.

F. S. Terry, National Electric Lamp Company.

Gerard Swope, Western Electric Company.

W. C. Bryant, the Bryant Electric Company.

F. J. Newbury, A. Roebling's Sons Company.

A. T. Clark, American Circular Loom Company.

W. H. Blood, Jr., president, the National Electric Light Association.

F. Bissell, the F. Bissell Company, representing the electrical jobbers.

James R. Strong, representing the electrical contractors.

It is probable that other members will be added to this committee from other interests whose representatives were unavoidably absent.

Each attendant at the banquet was given a neat souvenir pin as an association emblem.

Reviews of Current Engineering and Scientific Literature.

The Hydroelectric Equipment of Bellegarde, France.

A power station with an output of about 10,000 horse-power, employing vertical turbines, is being constructed at Bellegarde, France. It is here described by Mr. Frank C. Perkins. The energy will be distributed to a number of small electrical systems in the neighborhood. For this reason a rather low voltage has been adopted, and a frequency of 47.5 cycles per second. The hydraulic power of the Rhone has been utilized for many years for different industrial purposes at Bellegarde, about twenty-five kilometres below lake Geneva, and wire rope transmission was exclusively employed until electrical transmission made available a more complete and more economical method of utilizing the power. The equipment consists of alternators coupled directly to vertical turbines, each being furnished with a separate exciter, also driven by a small vertical turbine. There are altogether eight of these turbine groups. The water from the Rhone is conducted to the turbines partly by means of a tunnel and partly by a canal and pipe line. The turbines are of the Francis type and operate under a head of water of from eleven to fourteen metres. The largest turbines utilize about 14,000 litres of water per second, while the smallest take from 360 to 280 litres. The angular speed of the first is 114 revolutions per minute, while that of the latter is 430 revolutions. The revolving part of the alternator is supported by a turbine bearing. They are three-phase machines, varying in output from 800 horse-power, running at 133 revolutions per minute and giving 1,000 volts to 1,200 horse-power, giving 1,200 volts. The speed of the last machine is 114 revolutions per minute. The other turbines are rated varyingly from 900 to 1,500 horse-power and generate voltages of 2,000. Four of the latter machines are constructed so that the connections of the armature winding can be changed, the machines giving either 1,000 or 2,000 volts, as desired.—*Translated and abstracted from L'Électricien (Paris), March 3.*

The Time Constant of Polonium.

A note is published here by Frau Sklodowska Curie on the time constant of polonium, it being a reply to certain recent criticisms of a former note. Frau Curie says that her critics evidently have been working with radioactive bismuth, which contains a mixture of radium D, radium E and radium F. Radium E, as is well known, gives penetrating rays such as were given out by the bismuth under consideration, while polonium does not give such rays. She believes also that the bismuth under consideration contains lead. As is well known, radium D prepared from pitch-blende contains lead. The polonium with which she worked had been purified many times by fractional distillation, both from a nitrate solution in water and by heating the material with sodium hydrate. In this way the lead was removed. In both cases a bismuth salt is obtained or a bismuth oxide containing polonium which gives out only strongly absorbed rays. These peculiarities of polonium radiation have been pointed out many times. They have been studied again and again, and always give the same effect, and they have been described a number of times. Polonium can be identified only with radium F. It contains neither radium E nor radium D. Radium E, if present, would be detected quickly. During her investigation to determine the time constant of polonium, these peculiarities of the polonium radiation were discovered. Frau Curie possesses tested polonium which was prepared before 1900. This was a strongly active preparation several hundred times stronger than metallic uranium. It has now an activity which can not be measured, but which is certainly weaker than one one-hundredth of that of uranium. It is also evident that no radium D was contained in it. The radioactivity of lead prepared from pitch-blende increases continuously for many months and attains an activity which is not more than four times that of metallic uranium. This value indicates the equivalent weights of the three constituents of radioactive lead—radium D, radium E and radium F, and this equivalence remains practically constant during a number of years, because the disintegration of radium D apparently is very slow. According to Rutherford, the half value is reached in forty years. Frau Curie has some large mixtures of radioactive lead whose activity during three or four years has shown no noteworthy change and from these she can extract polonium.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), March 15.*

A New Process of Forming Insulation for Electric Conductors.

In this article a new process for applying cotton or silk insulation to electric conductors is described by M. J. Reyval. The new method is due to MM. Phillips and Hutchins, and is said to possess some distinct advantages over the insulation wound on in the usual way. The process is based upon the twisting and matting about the wire of the strands of the insulating material, thus forming a continuous, uniform coating, which presents no joints nor seams. The machine is very simple, consisting merely of a small spindle revolved at a high speed and suitable feeding rolls. The untwisted strands of cotton or raw silk are fed into the machine by the rolls which tend to separate it. In this condition it is sucked into the spindle by means of exhaust air. The wire to be coated is passed vertically down through the centre of the spindle and is fed forward at a fixed speed. The incoming strands of insulating material are twisted and woven around the wire by the joint action of the air and the rapidly revolving spindle. The result is a smooth, uniform coating on the wire, which can not be separated easily and which possesses considerable resistance to abrasion. The spindle revolves about 30,000 times a minute and is mounted on a long bearing lined with anti-friction metal and supplied bountifully with oil. The advantages claimed for the new system over the old method of twisting on strands of the insulating material are that the complete insulating covering is applied at one operation; there is no need to place a second layer over the first, as is the case where the coating is twisted on. The thickness of the insulation is under perfect control and can be regulated either by varying the speed at which the wire passes through the machine or by varying the supply of insulating material. The output of the machine is said to be considerably greater than that of the older type of apparatus. From some curves showing the relative output of the new machine as compared with the old for both silk and cotton covering, for wires insulated with cotton two millimetres in diameter, the cost of applying the insulation is only about two-thirds of that of the older way. For wires half a millimetre in diameter it costs less than half to insulate them by the new method with cotton. For still

smaller wires insulated with silk the difference is still more pronounced in favor of the new system. Another advantage is that the absence of any lateral strain on the wire makes it feasible to insulate wire having less diameter than that which can be covered in the old way. It is stated that each spindle can insulate from twenty-five to fifty metres of small-sized wire per minute, which is said to be ten times the work done by machines of the old type. —*Translated and abstracted from L'Eclairage Electrique (Paris), March 3.*

Recent Improvements at Anaconda.

During the last few years the large copper-smelting works at Anaconda have been much improved and increased. Before the change the large reverbatory furnaces for preparing the copper mat were the largest then known. They had hearth dimensions of twenty feet by fifty feet, and were smelting daily 105 tons of ore with a consumption of twenty-seven per cent of coal. As a first attempt, one of these furnaces was increased until the length of the hearth was sixty-five feet. The result was so encouraging that a further increase to eighty-five per cent, and finally to 102 feet, was made in the hearth. The width was maintained the same because of the structural conditions of the building. The furnace was so satisfactory that the fourteen furnaces, each twenty feet by fifty feet, were converted into seven large ones, each nineteen feet wide and varying in length from 102 to 117 feet. This was accomplished by throwing two furnaces, with the intermediate space, into one large one, so that the seven large furnaces had one-fourth more area than the fourteen smaller ones. As a result of these changes each large furnace now puts through 275 tons daily with a consumption of but twenty-one per cent of coal, this item having been reduced to a cost of $1 per ton of charge. The fireboxes are seven by sixteen feet, and burn about fifty-six tons daily. Following the change in the matting furnaces, the blast furnaces were attacked. These were seven in number, fifteen feet long and fifty inches wide, with a daily capacity of 420 tons each. To find out whether it would be possible to increase these furnaces correspondingly it was necessary to know if a jacket needing repair could be removed from existing furnaces without taking off the blast. Fortunately the jacket gets crusted over, forming a shield against the fire, so that the experiment was successful. Next, it was necessary to find out whether a part of the hearth could be cleaned out while the rest kept on smelting, at, of course, a decreased output. This was done successfully, and the space between two adjoining furnaces was bridged over, the jacket set up, the closed top and down-take added, thus completing the change from two smaller into one large furnace. In this way, with little interruption, a new furnace was constructed, the twenty-one feet intervening between the two being thrown into the two original fifteen-foot furnaces, so that the total made fifty-one feet in all. A heavy blast of air is used, and the new furnace has an output of 1,600 tons daily, with a maximum per furnace of 1,850 tons. This is an increase of nearly four times, although the jacket area in contact with the charge has been increased but 2.4 times. Thus there is proportionally less jacket water needed; also, it is easier to clean out accretions from the large furnace than from the smaller ones.—*Abstracted from the Mining and Scientific Press (San Francisco), March 3.*

Cost of Electric Railway Power and Transmission in the State of Indiana.

The results of an interesting examination of the costs of supplying power to electric railways in the state of Indiana are given here by Mr. A. S. Richey. There are about 800 miles of interurban electric railways in that state, on which 100 cars operate regularly. The average weight of the cars is 25.61 tons and their average schedule speed is twenty miles an hour. There are twenty-four power stations furnishing current to these cars, with a combined output of a little over 20,000 kilowatts, exclusive of the power station of the Indianapolis Traction and Terminal Company. There is therefore in the installed generators about 200 kilowatts for each interurban car operated and twenty-five kilowatts for each mile of track operated. Of the twenty-four stations, twelve deliver direct current and twelve alternating current through thirty-four substations. The individual ratings vary from 200 to 600 kilowatts. The units are of almost every rating from sixty-five to 1,500 kilowatts. Assuming a power consumption of 100 watt-hours per ton-mile, the average total power at the cars will be 5,000 kilowatts. The average load-factor of the power stations appears to be forty per cent of the aggregate rating; therefore the average output at the station bus-bars is over 8,000 kilowatts, which apparently indicates that the total losses in overhead lines, rail return, substation apparatus, step-up transformers, etc., amounts to more than 3,000 kilowatts, indicating an average efficiency from the power station bus-bar to car motors of about sixty per cent. As the assumption of 100 watt-hours per ton-mile is probably high, this average efficiency of distribution is to be considered higher, rather than lower, than the actual. The loss of forty per cent of the total power must be divided between the stations generating direct current and those generating and transmitting alternating current, converting in substations to direct current. But twenty per cent of the railway power generated in the state, outside of Indianapolis, is the output of direct-current generators. Allowing twenty per cent for the transmission losses from the direct-current stations leaves an efficiency of about fifty-five per cent for the remaining eighty per cent of the generated power, which is the output of the alternating-current stations. This low efficiency is due to the losses in the various transforming and transmitting devices. It seems low, but it is due to the fact that the average load on the substations is hardly more than one-quarter of their rated capacity. This difference in distribution efficiency between the alternating and direct-current systems seems surprising, and it undoubtedly accounts for a good deal of the cost of power to certain of the Indiana systems. There are a number of alternating-current systems which are supplying power at a considerably greater cost than would be the case had direct-current systems been adopted. On the other hand, there are a number of alternating-current systems which are considerably more economical than would have been the case had direct-current systems been adopted. An examination of the actual conditions in Indiana shows the following: the power stations generate an average of 5,845,000 kilowatt-hours per month at an average total cost of $44,156, or about 0.755 cent per kilowatt-hour. The average cost per kilowatt-hour is divided as follows: fuel, 0.526 cent; labor, 0.158 cent; lubricants, waste and miscellaneous supplies, 0.032 cent; repairs, 0.039 cent. The lowest total cost per kilowatt-hour reported is 0.505 cent, while the highest is 2.024 cents. These figures are for the cost of power at the station switchboards. As six of the thirteen stations reporting are alternating-current stations, the costs of the transmission losses must be added to the above figures. This brings the lowest cost to 0.747 cent and the highest to 2.024 cents, the average being 0.964 cent per kilowatt-hour. The roads reported a monthly car mileage for cities of 1,112,000 and for interurban lines 630,000 car-miles. The average power consumption was 1.48 kilowatt-hours per car-mile for city cars and 5.18 kilowatt-hours per car-mile for interurban cars. The average cost of power per car-mile on this basis is 1.43 cents for city cars and five cents for interurban cars. —*Abstracted from the Journal of the Worcester Polytechnic Institute (Worcester), March.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

THE EFFECT OF GENERAL ADVERTISING ON PRESENT CUSTOMERS.

BY CHARLES A. PARKER.[1]

You won't have to stumble up against many central station managers before you will be confronted by some such attitude of mind as is expressed in the question: "what's the use of advertising to people who are already our customers?"

Quite a lot of use.

You are supplying your customers right along with electricity, which they regard, in a passive way, as a good thing.

They take it as it comes, as a sort of matter of course, just about as they take the coming and the going of the seasons.

Despite the great advantages it offers them, it soon becomes a regular thing, to be accepted and welcomed, or tolerated, depending somewhat on the amount of their monthly bills.

Now it is one of the inexorable laws of nature that every man should view his monthly electric bill as an enemy to peace and happiness.

During the month he accepts his electric service placidly, without giving it any thought to speak of, but when his bill arrives he looks it over with a sour visage and begins to think and wonder and wonder.

That is the time he is apt to "teeter" on the fence of indecision.

There is nothing more calculated to make a man satisfied with his lot in life than to make him believe he is a lucky dog.

He isn't quite decided that his new overcoat suits him until his friends begin to praise it.

Why, half the people would lose faith in Ivory soap if it weren't eulogized regularly and persistently.

To make a man thoroughly pleased with his electric service you must keep him convinced of its advantages.

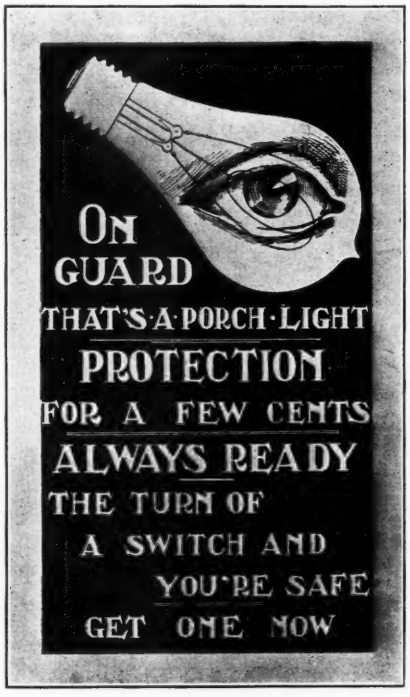
He may feel these advantages, in the abstract, but he seldom stops to enumerate or analyze them.

He entertains a vague, dreamy idea that electricity is a good thing to have, but the full force of the thing isn't borne in upon his understanding unless you remind him often enough so he will not forget.

A strong, aggressive, reason-giving campaign of advertising, directed to your people not only interests and enlists new customers, but it also has a tendency to keep your present customers satisfied.

They, naturally, get the notion that they have a good thing and are luckier than the poor souls to whom you are trying to explain the benefits of electric service.

Every time you advertise you give them from one to several good reasons why



A PORCH LIGHT SUGGESTION FROM THE DENVER GAS AND ELECTRIC COMPANY.

they should retain their electric service and perhaps increase it.

It cures apathy.

It discourages kicks.

It makes monthly bill paying a more agreeable transaction.

It fills their souls with the self-congratulatory feeling that they are progressive and up-to-date with the best light and heat and power agent known in this modern age—the very agent which is being so much agitated and talked about in your advertising.

And that is not all.

If you can manage to keep your customers satisfied, they invariably become walking, talking advertisements for you.

Remember, it is not absolutely necessary to inaugurate two distinct series of advertising, one for present users and one for prospective users.

The very line of argument which is calculated to appeal to non-users of electricity is the very line of argument which will refresh the memories of your present customers and keep them keen and alert to the advantages they are already enjoying.

Of course, you have no reason to make a direct appeal to your present customers to use electricity.

Simply prepare your advertising for the benefit of non-users, and it will act as a reminder and an argument for its retention by those who are already buying current.

Keep your customers satisfied and you will keep them good natured.

You will impress them with the true value of what they are enjoying.

You will, at the same time, prepare them to talk electricity to their friends who ask them as to its advisability.

Brilliant electric light, comfort-giving electric fans, clean, convenient electric chafing dishes, etc., in the home always furnish a source of comment on the part of callers who haven't these things in their own homes.

Therefore, anything that has an influence to put and keep your customers in a happy mood will naturally redound to your credit.

The whole question simmers down to one equation, and that is, you can kill two birds with one stone.

When you advertise to the folks you would like to sell current to, don't forget that the same identical appeal is nicely fitted to make your present customers better and more loyal customers, and the most human-influencing circulating advertisements for you.

It is one thing to secure a customer and it is another thing to keep him.

Maybe one requires more effort than the other.

We aren't just sure which.

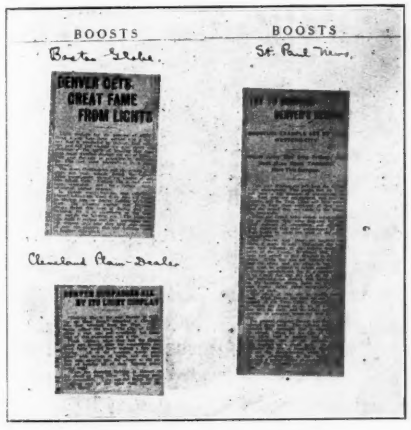
Why not give your present customers a chance to more fully appreciate the value

[1] Mr. Parker is the manager of the electrical department of the Curtis Advertising Company, of Detroit.

of electric service by issuing to them a campaign of forceful, convincing, attractive, direct-by-mail advertising?

The illustration on the opposite page is a reproduction of a mailing card from Denver. The matter of porch lights is one that is being advocated by central stations throughout the country. It is stated that a single porch light in a street means that in a very short time everybody in that street will have one. As a means of protection and security, as well as convenience, the porch light is fast gaining in popularity. The card illustrated herewith is pointed and is a sample of the kind of mail advertising that is accomplishing its purpose.

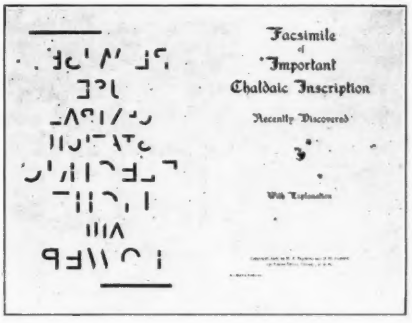
The Denver Gas and Electric Company, Denver, Col., has hit upon a novel idea in connection with its publicity department. The company has recently issued a booklet four and one-half by nine inches, containing clippings from various papers



FROM THE DENVER GAS AND ELECTRIC COMPANY.

throughout the country. This booklet has been issued under the title "Boosts." The cover is a mottled gray printed in black and red. The announcement is made that Denver is getting the attention of the world, because Denver is doing things. All over the country people have been reading of Denver as a city of lights. Every visitor of the thousands that will journey to Denver during the coming summer will compare Denver's light display with that of the cities with which he is familiar. The electric company concludes that it is up to Denver and her ever loyal business men to make the display such that the comparison will be favorable.

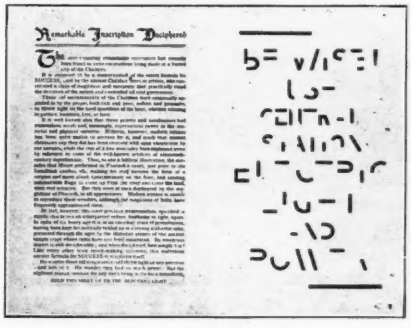
The Chicago Edison Company, Chicago, Ill., has originated a very interesting folder, which it is claimed has appealed to all classes of people who are able to use electric light and power. This folder was originated and copyrighted by Mr. D. H. Howard and Mr. H. A. Seymour, editor of *The Electric City,* and has just been used as a supplement to the March issue of this magazine, which is published by the Chicago Edison and the Commonwealth electric companies. As may be seen from the illustrations, the novelty con-



FIRST AND LAST PAGES OF FOLDER.

sists of a sketch referring to the alleged discovery of some Chaldaic inscriptions. The inscriptions are reproduced herewith. They are printed on the third and fourth pages of the folder. By properly superimposing the pages and holding to the electric light the legend is deciphered as follows: "be wise: use central station electric light and power." These folders may be secured in any quantity from the publisher, for use as a supplement to monthly bulletins, or to be used separately as an advertising folder to be sent to a selected list.

The accompanying illustration is a reproduction of a three-column advertisement in the Johnsonburg (Pa.) *Press.* This advertisement measured six and one-half inches by nineteen and one-half inches, and was the means of bringing the electric light company in close touch with its entire possible list of customers. The idea of inviting the consumers to become

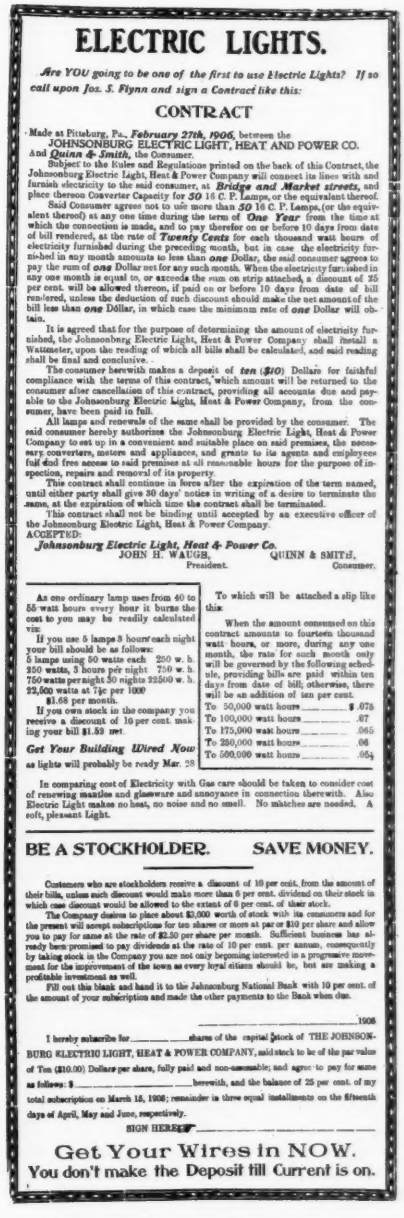


INSIDE PAGES OF FOLDER.

subscribers to the stock of the company is a good one for a town of this size, as a means of creating confidence and good will on the part of even those who are not in a position to become stockholders in the enterprise.

French Cable Company's Bill.

Secretary of State Elihu Root, on March 22, sent to the House a letter requesting the passage of a bill to reimburse the French Cable Company in the sum of $77,712, being for expenses incurred in repairing its cable and property, which were cut and damaged by the United States forces during the war with Spain. The



ELECTRIC LIGHTS.

Are YOU going to be one of the first to use Electric Lights? If so call upon Jos. S. Flynn and sign a Contract like this:

CONTRACT

Made at Pittsburg, Pa., *February 27th, 1905,* between the JOHNSONBURG ELECTRIC LIGHT, HEAT AND POWER CO. And *Quinn & Smith,* the Consumer.

Subject to the Rules and Regulations printed on the back of this Contract, the Johnsonburg Electric Light, Heat & Power Company will connect its lines with and furnish electricity to the said consumer, at *Bridge and Market streets,* and place thereon Converter Capacity for *50* 16 C. P. Lamps, or the equivalent thereof. Said Consumer agrees not to use more than *50* 16 C. P. Lamps, (or the equivalent thereof) at any one time during the term of *One Year* from the time at which the connection is made, and to pay therefor on or before 10 days from date of bill rendered, at the rate of *Twenty Cents* for each thousand watt hours of electricity furnished during the preceding month, but in case the electricity furnished in any month amounts to less than *one* Dollar, the said consumer agrees to pay the sum of *one* Dollar net for any such month. When the electricity furnished in any one month is equal to, or exceeds the sum on strip attached, a discount of 25 per cent. will be allowed thereon, if paid on or before 10 days from date of bill rendered, unless the deduction of such discount should make the net amount of the bill less than *one* Dollar, in which case the minimum rate of *one* Dollar will obtain.

It is agreed that for the purpose of determining the amount of electricity furnished, the Johnsonbrg Electric Light, Heat & Power Company shall install a Wattmeter, upon the reading of which all bills shall be calculated, and said reading shall be final and conclusive.

The consumer herewith makes a deposit of *ten ($10)* Dollars for faithful compliance with the terms of this contract, which amount will be returned to the consumer after cancellation of this contract, providing all accounts due and payable to the Johnsonburg Electric Light, Heat & Power Company, from the consumer, have been paid in full.

All lamps and renewals of the same shall be provided by the consumer. The said consumer hereby authorizes the Johnsonburg Electric Light, Heat & Power Company to set up in a convenient and suitable place on said premises, the necessary converters, meters and appliances, and grants to its agents and employees full and free access to said premises at all reasonable hours for the purpose of inspection, repairs and removal of its property.

This contract shall continue in force after the expiration of the term named, until either party shall give 30 days' notice in writing of a desire to terminate the same, at the expiration of which time the contract shall be terminated.

This contract shall not be binding until accepted by an executive officer of the Johnsonburg Electric Light, Heat & Power Company.

ACCEPTED:
Johnsonburg Electric Light, Heat & Power Co.
JOHN H. WAUGH, President. QUINN & SMITH, Consumer.

As one ordinary lamp uses from 40 to 55 watt hours every hour it burns the cost to you may be readily calculated viz:

If you use 5 lamps 3 hours each night your bill should be as follows:
5 lamps using 50 watts each 250 w. h.
250 watts, 3 hours per night 750 w. h.
750 watts per night 30 nights 22500 w. h.
22,500 watts at 7½c per 1000
$1.68 per month.

If you own stock in the company you receive a discount of 10 per cent. making your bill $1.53 net.

Get Your Building Wired Now as lights will probably be ready Mar. 28

To which will be attached a slip like this:

When the amount consumed on this contract amounts to fourteen thousand watt hours, or more, during any one month, the rate for such month only will be governed by the following schedule, providing bills are paid within ten days from date of bill; otherwise, there will be an addition of ten per cent.

To 50,000 watt hours	$ .075
To 100,000 watt hours	.07
To 175,000 watt hours	.065
To 250,000 watt hours	.06
To 500,000 watt hours	.054

In comparing cost of Electricity with Gas care should be taken to consider cost of renewing mantles and glassware and annoyance in connection therewith. Also Electric Light makes no heat, no noise and no smell. No matches are needed. A soft, pleasant Light.

BE A STOCKHOLDER. SAVE MONEY.

Customers who are stockholders receive a discount of 10 per cent. from the amount of their bills, unless such discount would make more than 8 per cent. dividend on their stock in which case discount would be allowed to the extent of 8 per cent. of their stock.

The Company desires to place about $3,000 worth of stock with its consumers and for the present will accept subscriptions for ten shares or more at par or $10 per share and allow you to pay for same at the rate of $2.50 per share per month. Sufficient business has already been secured to pay dividends at the rate of 10 per cent. per annum, consequently by taking stock in the Company you are not only becoming interested in a progressive movement for the improvement of the town as every loyal citizen should be, but are making a profitable investment as well.

Fill out this blank and hand it to the Johnsonburg National Bank with 10 per cent. of the amount of your subscription and made the other payments to the Bank when due.

_____ 1906

I hereby subscribe for _____ shares of the capital stock of THE JOHNSONBURG ELECTRIC LIGHT, HEAT & POWER COMPANY, said stock to be of the par value of Ten ($10.00) Dollars per share, fully paid and non-assessable; and agree to pay for same as follows: $ _____ herewith, and the balance of 25 per cent. of my total subscription on March 15, 1906; remainder in three equal installments on the fifteenth days of April, May and June, respectively.

SIGN HERE _____

Get Your Wires in NOW.
You don't make the Deposit till Current is on.

FROM THE JOHNSONBURG ELECTRIC COMPANY.

secretary declares that international good faith requires that the claim be paid, and that the United States is morally liable in the premises. It is not easy, he declares, to put forward satisfactory reasons for the omission to enact the measure before this time.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Line of Graphic Recording Electric Instruments.

The value of an accurate record of the performance of a central station or power plant will be readily appreciated by operating companies. It enables a close estimate to be made of fuel and supplies necessary for any season of the year, and affords a ready means of checking the efficiency of employés.

Such records can be made only by accurate recording instruments, a complete line of which has been placed on the market by the Westinghouse Electric and Manufacturing Company.

These instruments are arranged to operate on the relay principle, the motor element actuating contacts, which, in turn,

A NEW LINE OF GRAPHIC RECORDING INSTRUMENTS.

energize a pair of solenoids arranged to move the pen. They are designed for switchboard mounting and are enclosed in glass cases 13x16x9 inches, with a removable high glass front giving access to the interior.

The alternating-current ammeter, voltmeter and wattmeter coils are arranged in a manner similar to that of the standard line of precision instruments manufactured by this company; the registration is thus independent of frequency, external fields, temperature, voltage, of wave-form variation and equally correct on all power-factors. The wattmeters are made for single-phase and polyphase circuits, the latter being correct at any degree of unbalancing.

The power-factor and frequency meters have coils operating in the same manner as the corresponding Westinghouse indicating meters.

The direct-current ammeters operate from shunts, thereby avoiding the heavy wiring necessary for mounting on switchboards. Shunts already installed for indicating meters may also be used to operate these meters, affecting a considerable saving in cost.

The record is made by a special reservoir pen which is moved in a straight horizontal line across the paper, its motion being proportional to the quantity to be measured, thus giving a scale having rectangular coordinates. The reservoir contains a month's supply of the ordinary writing fluid used. The quickness of the pen's motion and consequently its sensitiveness may be easily regulated. Thus the record may be made to follow the slightest variation of the load, or else to slur these slight irregularities and form a more even line. The registering paper may be driven at speeds varying from two inches to eight inches per hour, and is arranged to unwind from a continuous roll. The speed may be changed very readily by inserting an extra set of gear wheels. Two inches per hour is the standard speed regularly furnished.

The recording paper is neatly printed, accurately ruled and punched, the width being approximately six inches—a deflection of five and one-quarter inches representing full load. It is furnished in rolls of sufficient length to last two months at two inches per hour.

The clock is an excellent self-winding high power design and requires no attention.

The meter coils consume no more energy than other Westinghouse switchboard instruments, ensuring correct ratio on the meter transformer.

The solenoids are energized from a separate source of current, so as to relieve the meter transformers of the power required, and are of sufficient torque to render the friction between the pen and the paper negligible.

The construction throughout is very rugged and compact, no delicate parts whatever being used.

Holophane "Pagoda Reflecting Arc."

The Holophane Glass Company, New York, N. Y., has placed upon the market a very effective fixture designated as the "Pagoda reflecting arc." A small compact cluster is used carrying small No.

"HOLOPHANE PAGODA REFLECTOR."

2631 Holophane "Pagoda" reflectors, the whole of this being surmounted by a large Holophane "Pagoda" reflector, giving a remarkably good distribution of light, and together with chain fixture effect presenting a very beautiful appearance. The shades, all consisting of clear glass, when lighted up, look very brilliant and altogether add greatly to the artistic part of any place where they are used.

A Single Casting of 125 Tons of Metal.

Patterns for what will be the heaviest single casting ever poured at the works of the Allis-Chalmers Company, Milwaukee, Wis., were completed recently in the pattern shops of the West Allis works. The casting is designed for the frame and slide of a horizontal rolling mill engine being built for the Carnegie Steel Company, Sharon, Pa. The cylinders will measure fifty and seventy-eight inches in diameter and have a sixty-inch stroke. The pattern for this piece, measuring thirty-two feet long, eleven feet wide and ten feet high, represents the work of ten expert pattern makers for a period of four

months. The amount of lumber of various sizes used in its making aggregated 22,000 feet. The pattern was taken from the pattern shop directly to the foundry, where work was begun on the construction of the mould. The pit in which the piece will be poured will be forty feet long, fifteen feet wide and eleven feet deep. The mould, when completed and ready to receive the molten metal poured in it, will take approximately 133 tons of iron. The actual pouring will consume from eight to ten minutes. Nine huge ladles will be used to convey the liquid metal to the mould. Four of these ladles will have five tons' capacity each, four twenty-five tons and one thirteen tons. After the metal is poured the casting will be allowed to stand for six days before the mould will be removed.

Two of the largest traveling cranes will be required to lift the casting, the aggregate weight of which will approximate 125 tons. It is expected that the finished piece will be ready for shipment in from seven to eight months' time. This will be loaded on one of the new sixteen-wheel, 100-ton flat cars now being built for the Allis-Chalmers Company at the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railway.

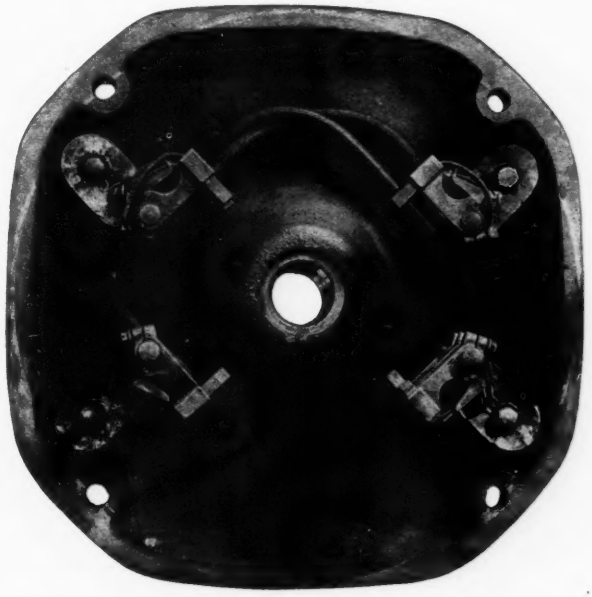
COMPLETE MOTOR WITH COVERS REMOVED.

CAST-STEEL FRAME, SHOWING LAMINATED PIECES BOLTED IN PLACE.

VIEW OF POLE-PIECE, SHOWING LAMINATIONS, HELD BY FOUR RIVETS. THE LARGER STUD IS USED TO HOLD POLE-PIECE IN PLACE BY MEANS OF BOLT THROUGH FRAME.

Hoisting Motors.

In meeting the demand for a motor especially designed for a particular form of service, the Western Electric Company, Chicago, Ill., has placed on the market the type "H" motor after a careful and exhausting study of hoisting service. The most important requirements of a motor for hoisting service are compactness, marked series characteristics and especial adaptability to intermittent service. The restricted space usually provided for motors of this type requires that the design shall be compact and that a minimum diameter of armature shall be used. This is compensated for by a longer armature than is generally employed in motors for continuous service. It is essential that the motor should have a comparatively low speed in order that the gear ratio may be a minimum. Not infrequently motors for hoisting service are called upon to withstand enormous overloads, sudden shocks and strains. A type of brake capable of stopping the motor almost instantaneously is often used, producing a heavy strain on the motor shaft. A motor, to withstand successfully service of this nature, must have great rigidity and be built from the best materials with the finest workmanship.



BEARING BRACKET, BRUSHES PERMANENTLY HELD IN A FIXED CENTRAL POSITION.

Hoisting service depends very largely upon torque. The work of an electric motor is directly proportional to the magnetic flux and also to the current flowing through the armature. The "H" design is such that the characteristics of the ordinary series-wound motor have been ac-

centuated. To accomplish this the magnetic circuit is of large area and low density under normal operating conditions, permitting a great increase in flux with an increase in load before the saturation point is reached. The armature has a minimum reactance upon the field, permitting operation through wide ranges of

FIG. 1.—TYPE "A" PORTABLE, VERTICAL POSITION.

load without sparking and with the brushes in the fixed central position necessary for reversible operation.

The accompanying illustrations represent the complete motor with covers removed, showing the compact design and the cast-steel frame with the laminated pole-pieces bolted in place.

FIG. 2.—TYPE "A" PORTABLE, HORIZONTAL POSITION.

The conditions under which hoisting motors operate often make it desirable that a completely encased motor be used for avoiding the injurious effects of dirt and water. This feature, as well as the usual inaccessibility and the consequent infrequent attention, require that the motor be designed with a wide margin for safety.

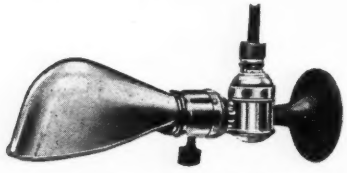


FIG. 3.—TYPE "C," ONE-LIGHT.

The Western Electric Company has paid particular attention to the rating of these motors, realizing the immense possibilities of this form of construction. The company states that a careful inspection of the motor will demonstrate that the problem of building a motor for hoisting service has been solved.

New Electrical Specialties.

The H. C. K. Company, 45 Broadway, New York city, has placed on the market a new line of adjustable electric portables and fixtures containing many points of more than ordinary merit.

Fig. 1 shows a type "A" portable in an upright position, Fig. 2 showing the type "A" portable in a horizontal position, as adapted for roll-top desks, pianos or filing cabinets. Placing the stem in the upright position makes the portable suitable for a flat-top desk or table.

Fig. 3 is the type "C" one-light key socket and shade, designed for suspension from the cord, and will balance properly and hang horizontally. It is fitted with a swivel joint between the cord support and the socket, and, having a rotatable shade, the light may be directed to any point desired. The fixture may be used as a portable, eleven inches high, by standing upright on the base.

Fig. 4 is designated as type "C" two-light key socket and shades. These horizontal key sockets swivel around the supporting cord or stem, and the lamp shades may be rotated on their sockets around the lamps, permitting the light to be directed and concentrated wherever required. The top cap is threaded for a three-eighth-inch pipe thread, so that the fixture can

FIG. 4.—TYPE "C," TWO-LIGHT.

be screwed on to any standard outlet. The swiveling motion is limited to one full revolution, obviating collector rings, brushes or other working contacts. This fixture may be used either as a one-light fixture or as a two-light fixture by removing one lamp and socket and substituting the balancing weight illustrated in Fig. 3. Each lamp in this fixture is independent, as it has its own key socket, and no other socket is required for the fixture.

Fig. 5 and Fig. 6 show two applications of the type "D" adjustable bracket. The square tube or stem may be moved in or out and set at any angle desired. At the end of the square tube there is a double-sided hinge with two thumb nuts to hold it in place, doing away with riveted joints. The shade may be rotated around the socket, directing the light to the exact point desired. When the light is not required the bracket may be pushed out of the way against the wall, as illustrated in Fig. 6.

The eight-candle-power lamp in H. C. K. fixtures is said to be ample for a good working light.

The H. C. K. Company has been organized to manufacture a line of improved designs of electric light fixtures and kindred specialties. These designs are largely the result of a long engineering experience by Mr. J. H. Hallberg, and will

FIG. 5.—ADJUSTABLE WALL BRACKET, TYPE "D."

serve to meet the needs discovered by him for more serviceable and convenient fixture devices.

The officers of the company are as follows:

J. H. Hallberg, president and consulting engineer. Mr. Hallberg was for several years a designer of arc-lighting apparatus with the General Incandescent Arc Light Company, and later was the general superintendent of the Cincinnati Gas and Electric Company. Mr. Hallberg's connection with the H. C. K. Company will not interfere with his consulting engineering business.

H. B. Coles, vice-president and sales manager. Mr. Coles was secretary of the General Incandescent Lamp Company, of Cleveland, Ohio, for several years, and later acted as manager of the Cleveland and Cincinnati offices of the General Incandescent Arc Light Company. After that he was general manager of the Southern Electric Company, of Baltimore.

P. H. Klein, Jr., secretary and treasurer. Mr. Klein is well known throughout the electrical industry as past-president of the New York Electric Equipment Company, past-president of the New York

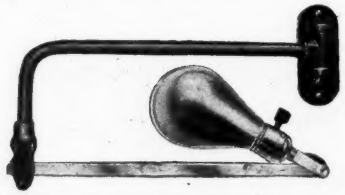


FIG. 6.—ADJUSTABLE WALL BRACKET, TYPE "D."

Electrical Contractors' Association and treasurer of the Bergman and General Incandescent Arc Light companies. About a year ago he resigned from the Stanley-G. I. Electric Manufacturing Company.

The board of directors of the company consists of J. H. Hallberg, H. B. Coles, P. H. Klein, Jr., and George H. Benjamin.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

RAILWAY, LIGHT AND POWER COMPANY FOR GUATEMALA—The Guatemala Tramway, Light and Power Company has received a charter from the state of New Jersey. The corporation purposes building and operating street railways, telephone and telegraph lines, electric light and gas plants in the republic of Guatemala. The capital stock is $4,000,000, divided into equal amounts of common and preferred.

BRITISH TELEPHONE CALLS IN 1905—The National Telephone Company, of England, reports that 1,053,000 messages were sent over the company's lines in 1905. In the same period 88,000,000 inland telegrams were sent. The increase in the use of the telephone is shown by the fact that the 1905 calls were 53,000,000 in excess of those for 1904. London, with a population of 6,500,000, against New York with a population of 5,500,000, has 100,000 telephone stations, as compared with 280,000 in New York.

NEW RAILWAY FOR PIKE'S PEAK, COL.—The announcement is made that the owners of the Pike's Peak cog railway, near Colorado Springs, Col., are negotiating for patent rights under which they propose to construct an electric road up the east side of the slope to the summit. The project contemplates the use of several inclines, the motive power on which is covered by the patents in question. This line will replace the present cog-wheel road and, in addition to making a finer scenic line than the present one, will be available for use for practically the whole year.

MERGER OF PUBLIC UTILITY CORPORATIONS OF MOLINE, ILL.; ROCK ISLAND, ILL., AND DAVENPORT, IOWA—The merger is announced of the public utility companies of Moline, Rock Island and Davenport into the Tri-City Railway and Light Company. The companies concerned are the Tri-City Railway Company, the People's Power Company, the People's Light Company and the Moline, East Moline & Watertown Interurban Railway. The price paid was $8,115,000, and $2,000,000 more will be paid for the Walsh street car and light companies of Davenport.

LAKE COUNTY (CAL.) POWER COMPANY—Articles of incorporation have been filed at Lakeport, Lake county, Cal., by the Lake County Power Company, with a capitalization of $10,000,000. Lakeport will be the principal place of business of the corporation, which has been formed for the purpose of carrying on in Lake and other counties of California the generating and selling of electricity for lighting purposes, the acquisition of real and personal property and water rights, and for the manufacture and sale of ice. The directors of the company are Wilbert T. Mariner, Herbert V. Keeling, M. S. Sayre, B. H. Henderson and A. H. Spurr, all of Lakeport.

RAILWAY FROM LOS ANGELES TO SAN DIEGO—Articles of incorporation of the Los Angeles & San Diego Beach Railway Company have been filed. The articles state that it is the purpose of the company to construct an electric railway from Los Angeles through Orange county and Santa Ana to San Diego, and also to Tia Juana. It is also stated that a number of electric street railways are to be built in the city of San Diego. The company is capitalized at $6,000,000, and of this amount it is stated that $165,000 has actually been subscribed. The directors of the company for the ensuing year are as follows: E. S. Babcock, A. E. Babcock, R. B. Talbot, A. E. Lillicrap and James Stroup.

HANNAWA FALLS POWER COMPANY STARTED UP—The transmission line of the Northern Power Company, of Potsdam, N. Y., to Ogdensburg, N. Y., has been successfully placed in operation. The power is developed at the plant of the Hannawa Falls Water Power Company at Hannawa falls on the Racquette river, near Potsdam, N. Y. The transmission line runs across country thirty-five miles to the city of Ogdensburg, where power is delivered to the Ogdensburg Street Railway Company, which uses it to operate the street railway and lighting systems. The transmission line is made up of aluminum cable. W. C. Johnson, of Niagara Falls, is the consulting engineer, and W. T. Cogswell and E. J. Page, of Syracuse, N. Y., are the president and vice-president, respectively, of the Northern Power Company.

TO BUILD NEW LONG ISLAND TROLLEYS—The corporation known as the Long Island Electrical Companies, all of the stock of which is owned by the Long Island Railroad, and the bonds of which are guaranteed by the latter, now includes six trolley companies, the construction cost of which aggregates $779,235. In addition to this the company has acquired half of the stocks and bonds of the New York & Long Island Traction Company and the Long Island Electric Railway Company. It is proposed to build new lines this year to cost, with extensions, $500,000. This makes a total of $2,640,000 that will be needed at once, which, when taken from the new authorized bond issue of $10,000,000 will leave $7,360,000 for future extensions. The lines now in existence and to be constructed at once will earn $100,000 a year, it is estimated.

FIVE-MILLION-DOLLAR TELEPHONE CORPORATION—The Central Home Telephone Company, a $5,000,000 corporation, has been organized to purchase fifteen or twenty of the independent telephone systems in Kentucky and southern Indiana. The arrangements have been practically completed, and companies at Owensboro, Henderson, Maysville, Paducah and Bowling Green, Ky., and Bedford and Bloomington, Ind., have been taken over. The Central Telephone Company, while primarily a holding company, is also a building and organization company. Arrangements either to buy outright or to secure controlling interest in not less than fifteen independent companies in Kentucky and southern Indiana have been completed. It is not the intention of the company to stop at this, and the holdings will be extended as rapidly as possible to as many of the independent companies in the Ohio valley as are willing to enter the organization.

WISCONSIN TELEPHONE COMPANY TO SPEND LARGE SUMS FOR IMPROVEMENTS—The estimated expenditures of the Wisconsin Telephone Company for the year will approximate $1,500,000. The cost of improvements made by the company in the Milwaukee exchange during the past year amounted to $305,000. These facts were brought out at the annual meeting of the stockholders, which was held in Milwaukee on March 5. The following officers were elected: president, Alonzo Burt; vice-president, John D. McLeod; treasurer, C. J. Linn; secretary, Charles A. Grant; general manager, E. B. Cottrill; auditor, O. B. Koepke; engineer, C. W. Burkett. The following directors were elected: Alonzo Burt, Julius O. Frank, Oliver C. Fuller, Ira B. Smith, Edward A. Uhrig and Henry F. Whitcomb, of Milwaukee; John Balch, Philip Dexter, Frederick P. Fish, Winfield S. Hutchinson and Thomas Sherwin, of Boston, Mass.

BILL RECOMMENDED TO LIMIT WATER SUPPLY TO POWER COMPANIES—On March 20 State Geologist Clarke made a statement before the assembly judiciary committee of New York state, at Albany, N. Y., to the effect that unless legislation is enacted to prevent the diversion of water from the Niagara river for power purposes there is grave danger of the channel on the American side of the falls running dry. In company with Commissioner Porter, of the Niagara Reservation, and Edward H. Hall, of the American Scenic Association, Mr. Clarke appeared before the committee and urged favorable consideration of the Cox and Foelker bills, which seek to protect the falls from the encroachment of the power companies. Mr. Foelker's bill was recommended as the one that will act at once to relieve matters, while the Cox bill is an amendment to the constitution, and it will be three years before it can become effective. The Foelker bill limits the existing corporations to the amount of water they are now using, and if they should exceed the amount after the passage of the bill they will forfeit their charters.

REPORT ON CHICAGO LIGHT PLAN—In a report based upon a ten days' investigation into the electric lighting situation in Chicago, Ill., Bion J. Arnold, consulting engineer, and William Car-

roll, city electrician, have advised the gas, oil and electric light committee of the city council that the proposition of the Chicago Edison and the Commonwealth Electric companies as a basis for a five-year agreement is reasonable if the value of the plants and other equipment is as represented by the corporations. In order to verify the investment feature both Mr. Arnold and Mr. Carroll declare that not less than three months' time will be necessary to inspect and appraise each plant. The proposition of the companies is for a reduction of the present rates (twenty cents a kilowatt-hour) to fourteen cents for the maximum and nine cents for the minimum for two years. This means a reduction of seven per cent from the present income, and 14.2 per cent from the income computed on the rates of last year. For the second period of three years the offer of the company is twelve cents a kilowatt-hour for the maximum, and eight cents for the secondary rate, a total reduction of 22.1 per cent from the income of last year.

BIRMINGHAM RAILWAY, LIGHT AND POWER COMPANY TO INCREASE CAPITAL STOCK—On March 30, 1906, a special meeting of the stockholders of the Birmingham Railway, Light and Power Company was held at Birmingham, Ala., for the purpose of considering and voting upon the following propositions: (1) to increase the capital stock of the company from $6,000,000 to $7,000,000 by the issue of 10,000 additional shares of six per cent cumulative preferred stock; (2) to allow each stockholder a preference in taking such increased stock at par in proportion to the amount of the original stock he may own, such preference to be exercised within sixty days after such increase of stock has been agreed upon; (3) to authorize the directors to sell, at not less than par, and in such manner and to such persons as they may determine, so much of such increased stock as may not be taken by the stockholders; (4) to authorize the execution and delivery to the Commercial-Germania Trust and Savings Bank, as trustee, of a mortgage supplemental to the mortgage heretofore executed and delivered by the company to the trustee, dated August 1, 1904, in order to further secure the general mortgage refunding four and one-half per cent bonds of the company.

PHILADELPHIA (PA.) TRACTIONS—At a meeting on March 20, at the mayor's office in Philadelphia, Pa., of the officials of the city and those of the Philadelphia Rapid Transit Company, the rapid transit company agreed to complete, within three years, a subway under Market street from Fifteenth street to the Delaware river; a subway under Broad street from Walnut street north; a subway under Walnut street from Broad street to Fifth street; under Fifth street to Arch street, and under Arch street to Broad street; and an elevated line from South street and Delaware avenue to Frankford. The company has surrendered the following franchises: for a subway under Chestnut street, thus clearing the way for the proposed line of the Philadelphia & Western Railway; for surface lines on Broad street; for elevated railroads on Ridge avenue, Passyunk avenue and Germantown avenue; for elevated roads on Lancaster, Baltimore and Woodland avenues in west Philadelphia, all of which were to be connecting links with the Market street elevated. These, it is assumed, will now go to the Philadelphia & Western, and will give that company ample opportunities in the western and southwestern sections of the city.

PERSONAL MENTION.

MR. RALPH D. MERSHON, consulting electrical and mechanical engineer, has removed his New York office to 60 Wall street. Mr. Mershon's Montreal (Canada) offices are in the Street Railway Chambers.

MR. E. C. WILEY, formerly chief clerk to General Manager H. F. Stevens, of the Bell Telephone Company, has accepted the position of auditor for the Hudson River Telephone Company, with headquarters at Albany, N. Y.

MR. F. D. LAWRENCE, president of the F. D. Lawrence Electric Company, Cincinnati, Ohio, large dealer in electrical supplies, spent last week in New York city. Mr. Lawrence reports a very busy season, and expects a still larger demand for electrical apparatus during the spring and summer.

MR. J. A. FARLEY, chief inspector of the Southern Bell Telephone Company, with headquarters at Wilmington, N. C., has been promoted to chief district inspector, and will travel through North Carolina and part of South Carolina. He will be succeeded at Wilmington by Mr. L. H. White, of Clinton, S. C.

MR. J. T. RICE has been appointed manager of the Houston (Tex.) exchange of the Southwestern Telegraph and Telephone Company, taking the place of Mr. Frederick Linington, who has been promoted to the superintendency of the construction department of the system in Arkansas. Mr. Rice was local manager at Austin for the Southwestern Telegraph and Telephone Company.

MR. ANTHONY J. BEMIS has assumed the managership of the Grand Rapids-Muskegon Water Power Electric Company, Grand Rapids, Mich. Mr. Bemis has been identified with Stone & Webster, Boston, Mass., as an expert electrical engineer, for the past nine years. He went to Grand Rapids last August to take charge of the construction of the Grand Rapids-Muskegon company's plant and to look after its organization.

MR. L. D. BRAINERD, who for the past few months has been manager of the Rome (N. Y.) exchange of the Bell Telephone Company, has been promoted to the position of acting district manager at Cooperstown, N. Y. C. J. Ernest, who has been superintendent of contract work at Rome, has been appointed manager. Mr. Fred E. Crane, the general foreman for the company, has been promoted to district general foreman of the Utica district, with headquarters in Utica.

SIR GEORGE DARWIN, K. C. B., second son of Charles Darwin, arrived in New York on Friday, March 23, from Liverpool, England. He has come to this country as the representative of the British Association to attend a celebration of the 200th anniversary of the birth of Benjamin Franklin, which is to be held soon in Philadelphia. He brings with him an address of congratulation from his society to the American Philosophical Society, which was founded by Franklin in 1743. Lady Darwin, who is with him, is a native of Philadelphia. They expect to remain in this country for about a month.

COLONEL W. T. GENTRY, vice-president and general manager of the Southern Bell Telephone and Telegraph Company, entertained at dinner at the Capital City Club, Atlanta, Ga., on the evening of March 15, Mr. Edward J. Hall, president of the Southern Bell Telephone Company, and vice-president of the American Telephone and Telegraph Company; Charles H. Wilson, general superintendent, American Telephone and Telegraph Company, and H. S. Brooks, assistant general superintendent, American Telephone and Telegraph Company. The dinner was a brilliant affair in every way, and was attended by a number of well-known residents of the city.

OBITUARY NOTICE.

DR. ROBERT OGDEN DOREMUS, the well-known chemist, died on Thursday, March 22 at his home in New York city. Dr. Doremus was taken ill ten days prior to his death, and the trouble was diagnosed as an arterial breakdown due to advanced age. His sons, Dr. Charles A. Doremus, Thomas C. Doremus and Arthur L. Doremus, with their sister, Miss Estelle Doremus, were present when death came. Dr. Robert Ogden Doremus was born in New York city, January 11, 1824, and his father was one of the founders of New York University. Dr. Doremus entered Columbia College in 1838, remaining there one year, when he entered New York University. He was graduated in 1842 with the degree of A. B. He subsequently took the degree of A. M. in 1845, and was graduated from the medical department in 1850. In 1847 Dr. Doremus visited Europe and studied electrometallurgy in Paris. In 1850, associated with several prominent men, he founded the New York Medical College, and equipped the first chemical laboratory in the United States in which medical students were required to make a practical study of chemistry. Dr. Doremus was for more than fifty years prominently identified with medical education in this country. In 1861 Dr. Doremus resigned from the chair of professor of natural history of the Free Academy, and traveled in Europe in the interests of an invention for the reduction of granulated gunpowder by compression. On his return he became professor of chemistry and physics of the Free Academy. Soon afterward the name of the institution was changed to that of the College of the City of New York. Dr. Doremus was a constant contributor to the daily press and the leading periodicals, and was editor-in-chief for the department of chemistry of the Standard Dictionary. He was a fellow of the New York Academy.

ELECTRICAL SECURITIES.

While price changes have been fairly wide during the past week, the stock market has been uneventful from a speculative standpoint. The public's market interest, as reflected in commission-house business, was decidedly dull. It is claimed that there have been too many uncertainties of late, and that professional predictions have been so at variance with actual conditions that unless some real stimulus comes along there will be witnessed a period of inactivity which will last for some time. Professional sentiment, however, is confident, and with a general tendency toward bullishness. The coal labor situation still continues to be a dominant factor, and at the present time conditions are more strained than they have been during any phase of the controversy. Those who ought to know, however, seem to be of the opinion that if there is a strike it will be a partial one, and in this wise greatly lose its effect as an adverse factor. The general industrial news and developments show no marked change. As was pointed out last week, there has been a seasonable lull in the iron industry, and the prospect of a coal strike is having an adverse influence in the iron market. It is stated that record earnings of last year are being exceeded by practically every important railroad system. While this is not given so much attention it is really one of the most significant illustrations of commercial prosperity.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 24.

New York:	*Closing.*
Allis-Chalmers common	21⅛
Allis-Chalmers preferred	56½
Brooklyn Rapid Transit	83
Consolidated Gas	145¼
General Electric	166½
Interborough Rapid Transit	228
Kings County Electric	175
Mackay Companies (Postal Telegraph and Cables) common	59
Mackay Companies (Postal Telegraph and Cables) preferred	72½
Manhattan Elevated	157
Metropolitan Street Railway	112¼
New York & New Jersey Telephone	153
Western Union	92
Westinghouse Manufacturing Company	161

The directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred, the assenting and the non-assenting stocks, payable April 30. Books closed March 30 and will reopen April 11. At a meeting of the stockholders of the Westinghouse Electric and Manufacturing Company, held March 26, the increase of the capital stock from $25,000,000 to $50,000,000 and the issuance of $15,000,000 of convertible 5 per cent bonds were authorized. Of about 500,000 shares 389,542 were represented at the meeting. The new stock received the same preferences and priorities as the so-called assenting stock.

Boston:	*Closing.*
American Telephone and Telegraph	138
Edison Electric Illuminating	247
Massachusetts Electric	68
New England Telephone	138½
Western Telephone and Telegraph preferred	89½

The American Telephone and Telegraph Company's instrument statement for February is as follows: gross output, 161,775; returned, 48,842; net output, 112,933, as compared with 86,724 for February, 1905. For the two months ending February 28 the statement shows as follows: gross output, 338,382; returned, 112,066; net output, 226,316, as compared with 179,658 for the same period of 1905. The total now outstanding is 5,924,574, as against 4,660,222 for the previous year.

The report of the Western Telephone and Telegraph Company for the year ended January 31 is as follows: interest, $431,523; dividends, $1,028,324; miscellaneous, $4,995, making the total net receipts, $1,464,842; interest and taxes, $543,168, and general expenses, $34,247, a total of $577,415, leaving net revenue of $887,426; dividends, $800,000; surplus, $87,426, as compared with $75,091 for 1905. President Fish states that the number of exchanges operated at the end of 1905 was 352. The stations connected with these exchanges numbered 180,430, an increase of 30,999. To this number are to be added 67,114 stations of subsidiary companies in which a controlling interest is owned, which lease the Western company's telephones and operate them under contract in small towns and rural districts, making a total of 247,544 stations, as compared with 200,890 at the close of the previous year. The expenditure for new construction during the year was $4,564,308.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	80
Electric Storage Battery preferred	80
Philadelphia Electric	7¾
Philadelphia Rapid Transit	28¼
United Gas Improvement	94½

The Electric Storage Battery Company has issued its annual report for the year ended December 31, 1905. The income account is as follows: gross, $1,467,486; expenses, $389,032; net $1,078,454; other income, $135,533; total income, $1,213,987; dividends, $812,440; surplus, $401,547, as compared with $270,473 for the previous year. At the annual meeting of the company the old board of directors was reelected.

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	153
Metropolitan Elevated preferred	69
National Carbon common	86
National Carbon preferred	119
Union Traction common	5
Union Traction preferred	18

The annual meeting of the Metropolitan Elevated will be held April 4. Books closed March 21 and will reopen April 5.

The National Carbon Company has declared a dividend of 1 per cent on the common stock, payable April 14. Books close April 4 and reopen April 16.

The Chicago Telephone Company has declared a quarterly dividend of 2½ per cent, payable March 31. Books closed March 26 and will reopen April 2.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—A meeting of the New York section of the American Electrochemical Society was held on Thursday evening, March 22, at 8.30 o'clock, at Havemeyer Hall, Columbia University. A paper was read by Dr. Richard von Foregger, entitled "Some Uses of Fused Sodium Peroxide." At the conclusion of the regular business meeting the members inspected the new electrochemical laboratories of Columbia University, Professor Samuel A. Tucker, of the department of electrochemistry, explaining their object and arrangement.

ST. LOUIS BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—On March 14 the St. Louis branch of the American Institute of Electrical Engineers held a meeting at Lippe's Café, A. H. Timmerman presiding. The members dined informally at 6.30 P. M., and immediately following the dinner Mr. Richard McCulloch, assistant general manager of the United Railways Company, gave a brief description of the rotary substation at Seventeenth and Locust streets. After the address the members adjourned in a body to visit the station. The evening was spent in inspecting the apparatus. It was announced that on the occasion of the April meeting a lunch and smoker will be provided, through the courtesy of the Pittsburg Reduction Company, by Mr. J. H. Finney, the St. Louis manager.

ELECTRIC CLUB, PITTSBURG, PA.—On Thursday evening, March 15, Mr. J. W. Lieb, Jr., third vice-president and associate general manager of the New York Edison Company, lectured before the members of the Electric Club, at Pittsburg, an organization composed of apprentices and engineers of the Westinghouse companies, on the subject of "Generation and Distribution of Current for Lighting and Power on Manhattan Island." Mr. Lieb gave a statement of the growth of the apparatus and systems of his company from the earliest days, and presented in connection therewith some excellent illustrations by means of lantern slides. He cited various points in connection with the present operation, calling attention to variety of service in different sections of the city. He also showed load curves which were characteristic for different sections of the city, and showed the variations in these curves at different seasons of the year. The lecture was well attended and highly appreciated.

TELEPHONE AND TELEGRAPH.

GIFFORD, IDA.—An extensive system of farmers' telephones is being put in near Gifford.

SUMMITT, IDA.—A farmers' cooperative telephone line is being run from Summitt, Ida., to Cottonwood.

ELLENSBURG, WASH.—Five farm telephone lines are under construction in the vicinity of Ellensburg.

JOHNSTOWN, PA.—Beaverdale and Loydell have been added to the list of towns reached by the Johnstown Telephone Company.

ADAMSVILLE, TENN.—The Stantonville Telephone Company is building a line from Adamsville to Envilie, in Chester county, a distance of twelve miles.

JAMESTOWN, N. Y.—Finding its present building too small for its increased business, the Bell Telephone Company has decided to spend $40,000 in enlarging the plant.

PULLMAN, WASH.—The Ewartsville Telephone Company will extend its system from Pullman and Colfax, in Whitman county, to Pomeroy and other Garfield county points.

WENATCHEE, WASH.—Telephone lines are being extended north from Wenatchee into Okanagon county. Several new lines will be built in the vicinity of Conconully.

CHENEY, WASH.—Residents of Cheney have petitioned the county commissioners of Spokane county for a franchise for a telephone to extend eighteen miles out from that city.

CLARKSTON, WASH.—The Pacific States Telephone Company is preparing to install the central-energy system in Clarkston. Wires are now being strung, and the system will be installed as soon as the central building in Lewiston is completed.

MONTGOMERY, ALA.—The Southern Bell Telephone and Telegraph Company has elected the following officers: president, Edward J. Hall; vice-president and general manager, William T. Gentry; treasurer, D. L. Carson; auditor, J. M. B. Hoxsey.

FULTON, KY.—A working agreement has been reached between the Rural Telephone Association and the Cumberland system. Work on the rural exchange is now in progress on the Tennessee side of the city. There are about 700 telephones on the rural line.

FARNHAMVILLE, FLA.—The Farmers' Mutual Telephone Company has elected officers as follows: president, H. W. Beachman; vice-president, J. L. Summers; treasurer, Chas. Beachman; secretary, J. C. Crissinger; directors, A. Coon and Wm. Andrews.

TOLEDO, OHIO—The Grand Trunk purposes to establish a complete telephone system at an estimated cost of $200,000. A copper wire will be stretched from Portland, Me., to Montreal, Toronto, London, Port Huron, Detroit, Hamilton, North Bay and Chicago.

SAN DIEGO, CAL.—The Sunset Telephone Company is considering the matter of building a line from Julian, about fifty miles from San Diego, to Imperial. It is believed that the directors will authorize the building of the line and that it will be completed during 1906.

SAND POINT, IDA.—Arrangements have been made to build a telephone line from Sand Point to Hope, Ida. The Northern Pacific will permit the company to use its poles. The Spokane International Railway Company will put in a line from Sand Point to Bonners Ferry.

EDWALL, WASH.—The Colville Road Telephone Company, of Edwall, Wash., has let a contract to J. W. Whittaker, of Sprague, to build a telephone line from Edwall to Sprague, the company to furnish all material. The board of directors has been authorized to let the contract for stub lines.

GADSDEN, ALA.—The Independent Telephone Company, which was recently granted a franchise in Gadsden, will begin work immediately on its system. The proposed plans call for an expenditure of $100,000. Long-distance connections will be made with those cities where independent telephone systems are maintained.

CANON CITY, COLO.—The Colorado Telephone Company has since the first of the present year purchased land in the following cities, and will erect new central offices as soon as possible: Cripple Creek, Colorado City, Johnstown, Victor, Wellington, Longmont, Durango, Fort Morgan, Albuquerque, Las Vegas, Canon City and North Denver.

RICHMOND, IND.—The New Paris (Ohio) telephone exchange and entire rural system have been absorbed by a newly organized company. The organizers are A. C. Lindemuth, of Richmond; Colonel Rush, of Greenville; L. L. Lesh, of Eaton; S. C. Ritchie and T. C. Dowler, of New Paris. Colonel Rush will be manager of the system.

LEWISTON, IDA.—The Lewiston Waha Land and Irrigation Company, of Lewiston, has begun the construction of a private telephone line from that city to the 21 Ranch, near lake Waha, twenty-one miles from Lewiston. From Waha branch lines will be extended to the camps of the company, which is building irrigation canals in that district.

SALT LAKE CITY, UTAH—At the annual meeting of the directors and officers of the Rocky Mountain Bell Telephone Company the old officers were reelected as follows: president, George Y. Wallace; vice-president, George M. Downey; treasurer, W. S. McCornick; secretary, Robert B. Harkness; general manager, D. S. Murray; auditor, P. R. Ferguson.

BALLSTON SPA, N. Y.—The Hudson River Telephone Company has been given a franchise which, in addition to rights already enjoyed, gives it permission to lay conduits, the village receiving the free use of three telephones. The company expects to gradually install conduits in the business portion of the town in addition to entirely changing its present system.

UNIONTOWN, WASH.—The new trustees of the Uniontown Telephone Company have appointed the following officers: president, Lambert Taufen; vice-president, Dr. W. W. Miller; secretary and manager, Paul Fuchs; treasurer, L. F. Darr. The company is prosperous, the number of stockholders having increased materially. There are now 100 telephones in use, an increase of forty during the year. The company plans to extend its lines to Johnson this spring, where connection will be made with Pullman, Colfax and other towns.

GRAND RAPIDS, MICH.—Local owners of summer resort property at Port Sheldon Beach, on Pigeon lake, have taken steps to furnish telephone service to that vicinity. Articles of association have been filed with the county clerk for the organization of the Port Sheldon & Lake Shore Telephone Company, with a capital stock of $2,000. The incorporators are Judge Harry D. Jewell, Daniel E. Lozier, George Roeloffs, E. L. Bullen and Willanm G. Brummeler. It is proposed to install an independent line to connect with the trunk lines for all lake shore towns, Holland and Grand Rapids.

DUQUOIN, ILL.—The Duquoin, Anna, Marion and Carbondale telephone companies have been taken over by the Ohio & Mississippi Telephone Company, with a capital stock of $100,000, and general offices at Carbondale. This is a new company, formed especially for the purpose. A meeting of the promoters of the new company was held in Carbondale and the following officers and directors elected: president, Edward Sampson, Anna; vice-president, H. C. Miller, Duquoin; secretary, F. W. Willard, Anna; treasurer, D. M. Parkinson, Carbondale; general manager, E. J. Baldridge, Duquoin; directors: H. C. Miller and McBrookins, Duquoin; Joab Goodall and J. M. Mitchell, Marion; J. B. Bundy and D. M. Parkinson, Carbondale; Edward Sampson and A. J. Phillips, Anna.

NEW PUBLICATIONS.

AIR BRAKES FOR ELECTRIC CARS—A paper read before the New England Street Railway Association, November 23, 1905, by W. S. Bartholomew, entitled "Air Brakes for Electric Cars," has been reprinted as publication No. 9004 by the Westinghouse Air Brake Company. This paper makes a detailed study of the methods of brake application, the operating conditions, analyzes the elements of construction and describes and illustrates several standard and special equipments.

THE ILLUMINATING ENGINEER—The first issue of *The Illuminating Engineer*, March, creates a very favorable impression. The literature is interesting and the make-up clean and effective. The contents include the following: "A Year's Progress in Illumination," E. L. Elliott; "Illuminating Efficiency *vs.* Candle-Power Efficiency of Electric Lamps," George Loring; "A New Method of Show Window Lighting," Paul H. Jaehning; "Life of Incandescent Lamps as a Factor in Efficiency of Illuminating," Preston S. Miller; "Street Lighting," Hayden T. Harrison. Published by the Illuminating Engineering Publishing Company, New York.

ELECTRIC LIGHTING.

GOODWATER, ALA.—Goodwater has voted to install electric lights.

ASBURY PARK, N. J.—The Manalapan Light Company has put in operation its plant in Freehold.

DETROIT, MICH.—Grass Lake has placed in operation its new lighting plant. This was installed at a cost of $9,500.

HUTCHINSON, KAN.—A lighting franchise has been granted to the People's Water, Light and Power Company for a period of twenty years.

EDWARDSVILLE, ILL.—The McKinley syndicate has purchased the plant and franchise of the Granite City, Venice & Madison Electric Light Company.

WESTMINSTER, MASS.—Municipal street lighting for Westminster has been decided on. The power will be purchased from the street-railway company.

CORTLAND, N. Y.—An electric light plant, situated in Cortland and furnishing street lights at a much lower figure than is now paid by the village, has been planned by a number of capitalists.

UTICA, N. Y.—The Herkimer County Light and Power Company has let to the P. B. McCaghey Company a contract for the removal of rock and for the foundation and building to double the capacity of its power plant at Dolgeville.

SHAWNEE, OKLA.—The Santa Fe has placed in operation its new electric light plant which has just been completed in the south yard shops at a cost of $25,000. The plant will be used to furnish power for arc lights in the shops and yards, and for incandescents in the station building and depots.

WASHINGTON, D. C.—The bureau of yards and docks of the Navy Department has advertised for bids for the construction of a central power station at the New York Navy Yard. The estimated cost is $139,000. All the various power plants will be centralized, according to the plans of the Navy Department.

HONESDALE, PA.—The Lackawanna Light Company, formerly the West Scranton Light and Heat Company, has purchased ground for a power-house. The new building will cost about $20,000, and it is proposed to install about $100,000 worth of machinery and to begin the work of laying conduits and stringing wires immediately.

MUSKOGEE, I. T.—A franchise has been granted F. V. Archer for an electric lighting plant and street railway in Coalgate. Application will be made for similar franchises at Lehigh and Atoka. Mr. Archer is backed by Muskogee and Chicago capitalists, whose intentions are to construct an electric railway connecting Lehigh and Coalgate and to furnish lighting for the towns passed through.

BOULDER, COL.—J. J. Henry, of Denver, who holds an option on the Boulder Electric Light and Water Company for $250,000, has secured a twenty-five-year franchise for poles and transmission wires on county roads. He stipulates that he will build twenty miles of lines during the first year of the franchise, and give one-half of one per cent of the gross earnings for the first year to the county. The central station will be located at Lafayette, and power will be distributed to Fort Collins, Greeley, Lafayette and other towns. The franchise is given to Mr. Henry in trust, to be turned over to a company which will be organized by him.

SPOKANE, WASH.—At the annual meeting of the Washington Water-Power Company the trustees elected were H. M. Richards, J. P. M. Richards, Thomas G. Thomson, A. B. Campbell, J. D. Sherwood, J. N. Glover, Huber Rasher, D. L. Huntington and W. A. White, Frank Lyman and George Southard, of New York. The officers elected were: president, H. M. Richards; first vice-president, A. B. Campbell; second vice-president and general manager, D. L. Huntington; treasurer, H. E. Perks; secretary, H. L. Bleecker. The company plans several extensions and new lines during the coming year and will greatly increase its power output at Spokane and in Post Falls, Ida.

ELECTRIC RAILWAYS.

CLIO, MICH.—A franchise has been granted the Detroit, Flint River & Saginaw Valley Traction Company. The railway is to be completed by 1908.

NEWCASTLE, IND.—Information has reached this city to the effect that work on the Indianapolis, Newcastle & Toledo electric line will commence within six weeks.

LAWTON, OKLA.—George Baumhoff, a St. Louis millionaire, is at the head of the project to construct an electric line from Lawton to the Wichita mountains by way of Fort Sill.

MUSKOGEE, I. T.—Frank V. Archer, of Muskogee, has secured an electric light and street car franchise at Coalgate. Mr. Archer agrees to commence work on the construction of a plant immediately.

STOCKTON, CAL.—The new electric street railway system of the Central California Traction Company, which has been in course of construction during the past seven months, has been opened for general public traffic.

MILWAUKEE, WIS.—The Milwaukee Electric Railway and Light Company has ordered from the Allis-Chalmers Company three steam turbines, each of 1,500 kilowatts capacity, to be installed in the new terminal and office building on Sycamore street.

FAIRMONT, W. VA.—The building of the Fairmont & Mannington Electric Railway, connecting Fairmont with Mannington, will be commenced, the company having obtained a loan of $600,000 from the Pittsburg Trust Company. The line will be twenty miles in length.

NEW HAVEN, CONN.—Plans for the construction of a new electric railway between Willimantic and Coventry, to run abreast of the Willimantic river for a considerable distance, are said to be under consideration by the engineering department of the New Haven road, which owns the Consolidated Railway Company.

STERLING, ILL.—Announcement is made that the McKinley syndicate will build during the coming spring and summer a new electric interurban line in the northern part of the state, to connect at Springfield with the Illinois Traction system and to become a part of the great Illinois system of electric interurban railways.

NEWARK, DEL.—The statement is made authoritatively that the Delaware Interurban Railway will be built from Wilmington, Del., to Elkton, Md. This twenty-mile road will pass through a thickly populated section of two states. The company has franchises for the use of the streets in the various towns, including Newark.

STAUNTON, VA.—The stockholders of the Valley Traction Company, which purposes building a trolley line from Staunton to Middlebrook, have voted to increase their capital stock from $100,000 to $250,000. Richard Hogshead and J. Frank Tannehill have been added to the board of directors, and the work will be pushed as rapidly as possible.

FLINT, MICH.—The Detroit, Flint River & Saginaw Valley Railway Company, whose promoters have been securing franchises in Saginaw and Genesee counties for an electric road to be built from Saginaw to Flint, to connect with the Detroit United Railway, has been granted a franchise by the council, entitling it to rights and privileges in certain streets of the city.

CAMDEN, N. J.—The stockholders of the West Jersey and Seashore Railroad Company at the annual meeting approved the proposition to increase the capital stock of the company from $8,076,000 to $10,000,000. These directors were elected: A. J. Cassatt, George Wood, N. Parker Shortridge, Benjamin F. Lee, Josiah Wistar, William G. Nixon, Samuel Rea, Charles E. Pugh, John P. Green, W. H. Barnes, Israel G. Adams, William A. Patton, George S. Bacon, Robert W. Downing, John B. Thayer.

JOHNSTOWN, PA.—The charter rights and franchises of the Somerset County Street Railway Company have been sold to the syndicate headed by C. H. Jennings, of Maryland, who a few weeks ago secured a franchise of the streets of Salisbury and Meyersdale for a proposed electric line between Cumberland and Johnstown. The Somerset concern took out a charter two years ago for a proposed line from Paint Creek to Rockwood, paralleling the Somerset & Cambria branch of the Baltimore & Ohio. George R. Scull and William H. Ruppel, of Somerset, retain an interest in the Jennings syndicate.

INDUSTRIAL ITEMS.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, in the current issue of the "Pigeon-Hole," calls attention to Peerless motors for machine-shop operation.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in Bulletin No. 1201-A, describes and illustrates its "Universal" oscillatory movement, sifting mills. The text is in Spanish.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., is distributing a booklet listing a number of portable desk fans and ceiling fans of various forms. This booklet will be sent upon request.

THE BRILLIANT ELECTRIC COMPANY, 64-66 Chestnut street, Cleveland, Ohio, is mailing a special folder calling attention to the use of new Pagoda reflectors with eight, ten, sixteen and thirty-two-candle-power lamps.

THE DE LA VERGNE MACHINE COMPANY, New York city, has published an attractive pamphlet describing the Koerting two-cycle, double-acting gas engine. The text is supplemented by several half-tone engravings showing various parts of these machines.

THE STANLEY-G. I. ELECTRIC COMPANY, Pittsfield, Mass., in Bulletin No. 601 illustrates and describes its direct-current motors and generators. In addition to the technical data and views of parts, illustrations are given showing various applications of these machines.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, in bulletin No. 101 publishes a detailed description, with illustrations, of local battery telephones. In addition to the reproductions of apparatus many diagrams of circuits are given, making the literature of very great interest.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., in catalogue No. 063 describes and illustrates coal-handling machinery for power stations, boiler rooms, coaling stations, gas companies, coal yards, shipping docks and manufactories. This catalogue will be sent upon request.

THE AUTOMATIC CLUTCH COMPANY, Akron, Ohio, has ready for distribution a new pamphlet entitled "Clutchology," descriptive and illustrative of its automatic clutch. This clutch is a mechanical device for transmitting any degree of power and the company claims that the greater the load, the tighter is the grip, which is self-adjusting.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., manufacturer of Allen soldering flux and other electrical compounds, is in receipt of many letters from jobbers commendatory of the excellence of the Allen products. Numbers of these companies are pushing the Allen compounds with continued success in all parts of the country.

THE SYRACUSE SUPPLY COMPANY, Syracuse, N. Y., dealer in steam fittings, mill supplies, etc., has opened an electrical department and is carrying a full stock of specialties. This company has placed the electrical department in charge of Mr. F. S. Baldwin, late of the R. M. Cornwell Company, and is in the market for electrical supplies of all kinds.

THE H. T. CRIPPEN MANUFACTURING COMPANY, 25 Broad street, New York city, in catalogue No. 10 describes and illustrates box electric rock drills, electric hoists, electric pumps, mine and quarry equipment. This catalogue is very carefully arranged and, in addition to the literature of the subject, contains engineering data of considerable value.

M. W. DUNTON & COMPANY, Providence, R. I., are receiving many compliments upon the neat and attractive manner in which their "Nokorode" soldering paste is put up. The dainty enameled cans eliminate any soilage from greasy paper labels. The company reports a constantly increasing business, and states that "Nokorode" is making friends in every direction.

DODGE & DAY, Philadelphia, Pa., have issued a pamphlet describing the new factory in Baltimore, Md., recently completed for the piano manufactory of William Knabe & Company. The building was designed by Dodge & Day and erected and equipped under their supervision. This commission was the direct outcome of one of the preliminary reports with which these engineers have had such a large and varied experience.

THE ROBINS CONVEYING BELT COMPANY, Park Row Building, New York, is distributing a series of engineering sheets detailing various aspects of belt conveying and hoisting problems. These sheets are sent in answer to enquiries, the illustrations illuminating the explanation. The titles of the sheets are as follows: (1 and 2) Contractors' conveyers. (3 and 4) Automatic self-reversing trippers. (5) Tailings stackers. (6) Coal conveyers. (7) Picking belt conveyers. (8) Hoisting towers. (9) Belt conveyers in retail coal pockets.

THE MANHATTAN AUTO-CAR COMPANY, New York city, affords the visitor to New York an opportunity of making a swift pilgrimage to the many points of interest in the course of a day's run. The big twenty-passenger cars are familiar sights to New Yorkers. A well-informed guide accompanies each party, and points out the places of interest. The cars make regular trips, leaving the Saranac Hotel, Broadway and Forty-second street, every hour. Special trips are arranged for parties, and cars are sent to meet trains to accommodate out-of-town parties. B. W. Wrenn is president of the company.

THE CHARLES E. DUSTIN COMPANY, 11 Broadway, New York city, will send a complete list of bargains in electrical and steam machinery for central stations, street railways and isolated plants to any one in need of this material. In order to increase the facilities for handling apparatus and for the better convenience of its customers in inspecting, the company has moved its shops from Orangeburg, N. Y., to Jersey City, N. J. These shops can now be reached within a few minutes after leaving the New York office. The store-houses are commodious and a large portion of the stock is ready for immediate delivery and for inspection at all times.

THE H. W. JOHNS-MANVILLE COMPANY, New York, through its Chicago branch, has completed a large contract for the installation of "Fire Felt" pipe and boiler covering in the new plant of Sears, Roebuck & Company, of Chicago, involving an expenditure of several thousand dollars. This covering is fireproof, elastic, light in weight and unaffected by expansion or contraction of pipes. The above is one of many large contracts this company has recently executed. In addition to being extensive manufacturers of asbestos coverings, packings and roofing specialties, the H. W. Johns-Manville Company is one of the largest manufacturers of electrical supplies, with branches in all large cities.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., has ready for distribution catalogue No. 12. This is the latest edition of the company's electrical supply catalogue, and much time and consideration have been given to make it thoroughly up to date. The catalogue contents embrace 666 pages, and this is supplemented by a carefully arranged index of fourteen pages. The volume measures six and three-quarters inches by ten inches, and is bound in a substantial cloth and board cover. This catalogue appears to be very complete, and undoubtedly carries out the company's aim as a detailed listing of everything which might be used in an up-to-date electrical installation of any description.

THE RAIL JOINT COMPANY, New York, N. Y., has closed contracts for the enlargement and new equipment of its works at Troy, N. Y. These improvements will enable it to double its output of previous years. The company is now running day and night, while the improvements are in progress, to keep pace with the growing demands from steam and electric railroads for the three types of base supported rail joints known to the trade as the Continuous, Weber, and Wolhaupter types for tee and girder rail sections, also insulating and compromise or step joints to unite different sections of rails maintaining a perfect surface and doing away entirely with low joints. The general offices of the company are located at 29 West Thirty-fourth street.